PROPOSED
TOTAL MAXIMUM DAILY LOAD (TMDL)

For

Siltation & Habitat Alteration

In The

Lower Duck River Watershed (HUC 06040003)

Dickson, Giles, Hickman, Humphreys, Lawrence, Lewis, Maury, Perry and Williamson County, Tennessee

DRAFT

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ARAP	Aquatic Resource Alteration Permits
ARS	Agricultural Research Station
BMP	Best Management Practices
CFR	Code of Federal Regulations
CFS	Cubic Feet per Second
DEM	Digital Elevation Model
DWPC	Division of Water Pollution Control
EPA	Environmental Protection Agency
HUC	Hydrologic Unit Code
LA	Load Allocation
MGD	Million Gallons per Day
MOS	Margin of Safety
MRLC	Multi-Resolution Land Characteristic
MS4	Municipal Separate Storm Sewer System
NED	National Elevation Dataset
NHD	National Hydrography Dataset
NPS	Nonpoint Source
NPDES	National Pollutant Discharge Elimination System
NSL	National Sediment Laboratory
Rf3	Reach File v.3
RM	River Mile
RMCF	Ready Mixed Concrete Facility
STATSGO	State Soil and Geographic Database
SSURGO	Soil Survey Geographic Database
TDEC	Tennessee Department of Environment & Conservation
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
USGS	United States Geological Survey
USLE	Universal Soil Loss Equation
WCS	Watershed Characterization System
WLA	Waste Load Allocation
WMD	Water Management Division
WTP	Water Treatment Plant
WWTF	Wastewater Treatment Facility

SUMMARY SHEET

LOWER DUCK RIVER WATERSHED (HUC 06040003)

Total Maximum Daily Load for Siltation / Habitat Alteration in Waterbodies Identified on the State of Tennessee's 2002 303(d) List

Impaired Waterbody Information:

State: Tennessee
Counties: Dickson, Giles, Hickman, Humphreys, Lawrence, Lewis, Maury, Perry and Williamson
Watershed: Lower Duck River (HUC 06040003)
Watershed Area: 1,548 mi^2
Constituent of Concern: Siltation / Habitat Alteration
Impaired Waterbodies: 2002 303(d) List

Waterbody ID	Waterbody	RM
TN06040003023_0100	Quality Creek	7.1
TN06040003023_0200	Sugar Creek	13.6
TN06040003027_0100	Unnamed Tributary to Little Bigby Creek	2.0
TN06040003030_0100	Unnamed Tributary to Lytle Creek	1.6
TN06040003034_0300	McCutcheon Creek	21.8
TN06040003034_0700	Crooked Creek	2.5
TN06040003034_2000	Rutherford Creek	12.5
TN06040003050_0610	Grab Branch	3.9

Designated Uses: Fish & aquatic life, irrigation, livestock watering & wildlife, and recreation. Some waterbodies in watershed also classified for domestic and/or industrial water supply.

Applicable Water Quality Standard: Most stringent narrative criteria applicable to fish & aquatic life use classification:

Biological Integrity: The waters shall not be modified through the addition of pollutants or through physical alteration to the extent that the diversity and/or productivity of aquatic biota within the receiving waters are substantially decreased or adversely affected, except as allowed under 1200-4-3-.06.

Interpretation of this provision for any stream which (a) has at least 80% of the upstream catchment area contained within a single bioregion and (b) is of the appropriate stream order specified for the bioregion and (c) contains the habitat (riffle or rooted bank) specified for the bioregion, may be made using the most current revision of the Department's Quality System Standard Operating Procedure for Macroinvertebrate Stream Surveys and/or other scientifically defensible methods.

Interpretation of this provision for all other streams, plus large rivers, reservoirs, and wetlands, may be made using Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers (EPA/841-B-99-002) and/or other scientifically defensible methods. Effects to biological populations will be measured by comparisons to upstream conditions or to appropriately selected reference sites in the same bioregion if upstream conditions are determined to be degraded.

Habitat: The quality of instream habitat shall provide for the development of a diverse aquatic community that meets regionally based biological integrity goals. The instream habitat within each subecoregion shall be generally similar to that found at reference streams. However, streams shall not be assessed as impacted by habitat loss if it has been demonstrated that the biological integrity goal has been met.

TMDL Development

Analysis Methodology:

- Watershed Characterization System Sediment Tool (based on Universal Soil Loss Equation) applied to subwatershed areas corresponding 12-digit hydrologic unit code.
- Target sediment loads (lbs/acre/year) are based on the average annual sediment load from biologically healthy watersheds (Level IV Ecoregion reference sites).
- TMDLs, Waste Load Allocations (WLAs), and Load Allocations (LAs) are expressed as the percent reduction in average annual sediment load required for a subwatershed containing impaired waterbodies relative to the appropriate target load.

Critical Conditions: Methodology takes into account all flow conditions.

Seasonal Variation: Methodology addresses all seasons.

Margin of Safety (MOS): Implicit (conservative modeling assumptions).

TMDL/Allocations

TMDL and WLAs for Construction Storm Water Sites & MS4s; LAs for Nonpoint Sources:

HUC-12 Subwatershed	Level IV Ecoregion	Target Sediment Load	% Reduction - Avg. Annual Sediment Load		
			TMDL	WLAs (Construction SW & MS4s)	LAs (Nonpoint Sources)
		[lbs/acre/yr]	[%]	[%]	[%]
060400030101	71h	597.6	47.0	49.6	49.6
060400030102	71h	597.6	32.7	36.1	36.1
060400030201	71h	597.6	32.5	35.9	35.9
060400030202	71h	597.6	36.4	39.6	39.6
060400030303	71h	597.6	12.0	16.4	16.4
060400030701	71f	525.8	54.9	57.1	57.1

Note: The TMDL is the overall reduction in average annual sediment loading required for the HUC-12 subwatershed, whereas WLAs & LAs are the reductions required for individual construction storm water sites, MS4s, and nonpoint sources.

WLAs for WWTFs, Mining Sites, RMCFs & ARAP Activities:

WLAs for NPDES WWTFs, mining sites and RMCFs are equal to existing permit limits for total suspended solids (TSS). WLAs for sites undergoing activities authorized by an ARAP are equal to the permit requirements of the ARAP. Loading for these classes of facilities/sites are small compared to loading from construction storm water sites, MS4s and nonpoint sources.

TOTAL MAXIMUM DAILY LOAD (TMDL) FOR SILTATION/HABITAT ALTERATION LOWER DUCK RIVER WATERSHED (HUC 06040003)

1.0 INTRODUCTION

Section 303(d) of the Clean Water Act requires each state to list those waters within its boundaries for which technology based effluent limitations are not stringent enough to protect any water quality standard applicable to such waters. Listed waters are prioritized with respect to designated use classifications and the severity of pollution. In accordance with this prioritization, states are required to develop Total Maximum Daily Loads (TMDLs) for those water bodies that are not attaining water quality standards. State water quality standards consist of designated use(s) for individual waterbodies, appropriate numeric and narrative water quality criteria protective of the designated uses, and an antidegradation statement. The TMDL process establishes the maximum allowable loadings of pollutants for a waterbody that will allow the waterbody to maintain water quality standards. The TMDL may then be used to develop controls for reducing pollution from both point and nonpoint sources in order to restore and maintain the quality of water resources (USEPA, 1991).

2.0 WATERSHED DESCRIPTION

The Lower Duck River Watershed (HUC 06040003) is located in Middle Tennessee (Figure 1), primarily in Dickson, Hickman, Humphreys, Lewis, Maury, Perry and Williamson Counties (a very small portion of the watershed is in Giles and Lawrence Counties). The Lower Duck River Watershed lies within one level III Ecoregion (Interior Plateau) and contains three level IV Ecoregions (Western Highland Rim, Outer Nashville Basin and Inner Nashville Basin) as shown in Figure 2 (USEPA, 1997):

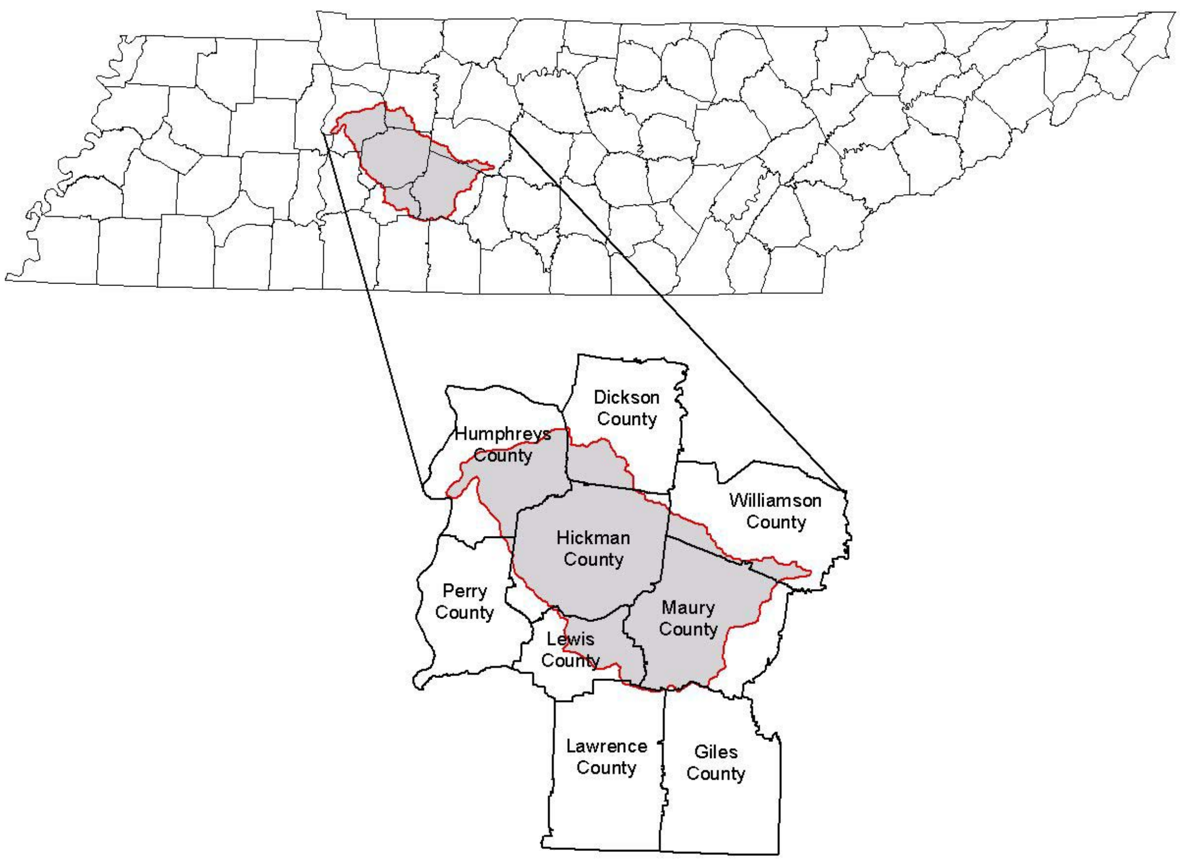
> **Western Highland Rim (71f)** is characterized by dissected, rolling terrain of open hills, with elevations of 400-1000 feet. The geologic base of Mississippian-age limestone, chert, and shale is covered by soils that tend to be cherty and acidic with low to moderate fertility. Streams are relatively clear with a moderate gradient. Substrates are coarse chert, gravel and sand with areas of bedrock. The native oak-hickory forests were removed over broad areas in the mid-to late 1800's in conjunction with the iron-ore related mining and smelting of the mineral limonite, however today the region is again heavily forested. Some agriculture occurs on the flatter interfluves and in the stream and river valleys. The predominant land uses are hay, pasture, and cattle with some cultivation of corn and tobacco.

> **Outer Nashville Basin (71h)** is a heterogeneous region, with rolling and hilly topography and slightly higher elevations. The region encompasses most all of the outer areas of the generally no-cherty Mississippian-age formations, and some Devonian-age Chattanooga shale, remnants of the Highland Rim. The region's limestone rocks and soils are high in phosphorus, and commercial phosphate is mined. Deciduous forest with pasture and cropland are the dominant land covers. Streams are low to moderate gradient, with productive, nutrient-rich waters, resulting in algae, rooted vegetation, and occasionally high densities of fish. The Nashville Basin as a whole has a distinctive fish fauna, notable for fish

that avoid the region, as well as those that are present.

Inner Nashville Basin (71i) is less hilly and lower than the Outer Nashville Basin (71h). Outcrops of the Ordovician-age limestone are common. The generally shallow soils are redder and lower in phosphorous than those of the outer basin. Streams are lower gradient than surrounding regions, often flowing over large expanses of limestone bedrock. The most characteristic hardwoods within the inner basin are a maple-oak-hickory-ash-association. The limestone cedar glades of Tennessee, a unique mixed grassland/forest cedar glades vegetation type with many endemic species, are located primarily on the limestones of the Inner Nashville Basin. The more xeric, open characteristics and shallow soils of the cedar glades also result in a distinct distribution of amphibian and reptile species. Urban, suburban, and industrial land use in the region is increasing.

Figure 1 Location of the Lower Duck River Watershed



The Lower Duck River Watershed has approximately 2,462 stream miles (RF3) and 13 lake acres in the Lower Duck River Watershed as catalogued in the assessment database. Land use for the Lower Duck River Watershed is summarized in Table 1 and shown in Figure 3.

Table 1 Land Use Distribution - Lower Duck River Watershed

Land Cover/Land Use	Area		
	[acres]	[mi^2]	% of Watershed
Bare Rock/Sand/Clay	10	0.02	0.00
Deciduous Forest	614480	960.13	62.07
Emergent Herbaceous Wetlands	224	0.35	0.02
Evergreen Forest	15627	24.42	1.58
High Intensity Commercial/Industrial/Transportation	5091	7.95	0.51
High Intensity Residential	809	1.26	0.08
Low Intensity Residential	5751	8.99	0.58
Mixed Forest	61224	95.66	6.18
Open Water	6784	10.60	0.69
Other Grasses (Urban/Recreational)	2749	4.30	0.28
Pasture/Hay	190343	297.41	19.23
Quarries/Strip Mines/Gravel Pits	810	1.27	0.08
Row Crops	73860	115.41	7.46
Transitional	5333	8.33	0.54
Woody Wetlands	6853	10.71	0.69
Total	**989948**	**1546.79**	**100.00**

Figure 2 Level IV Ecoregions in the Lower Duck River Watershed

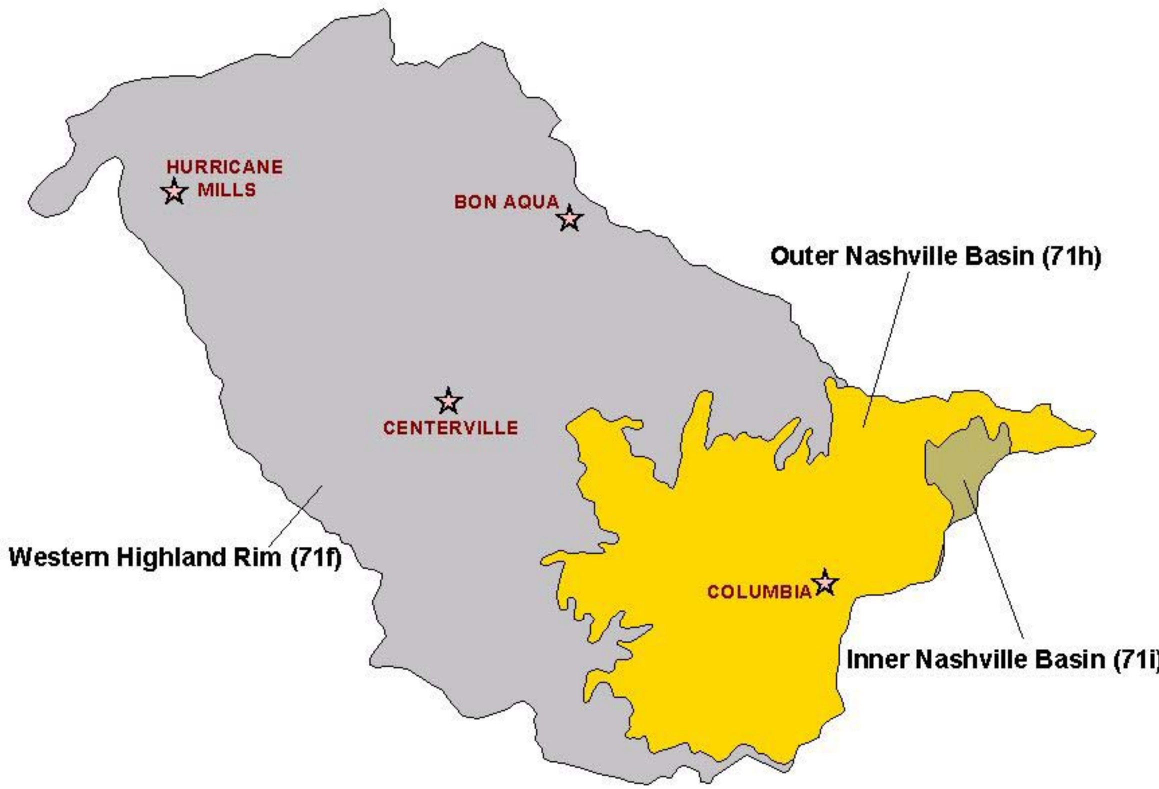
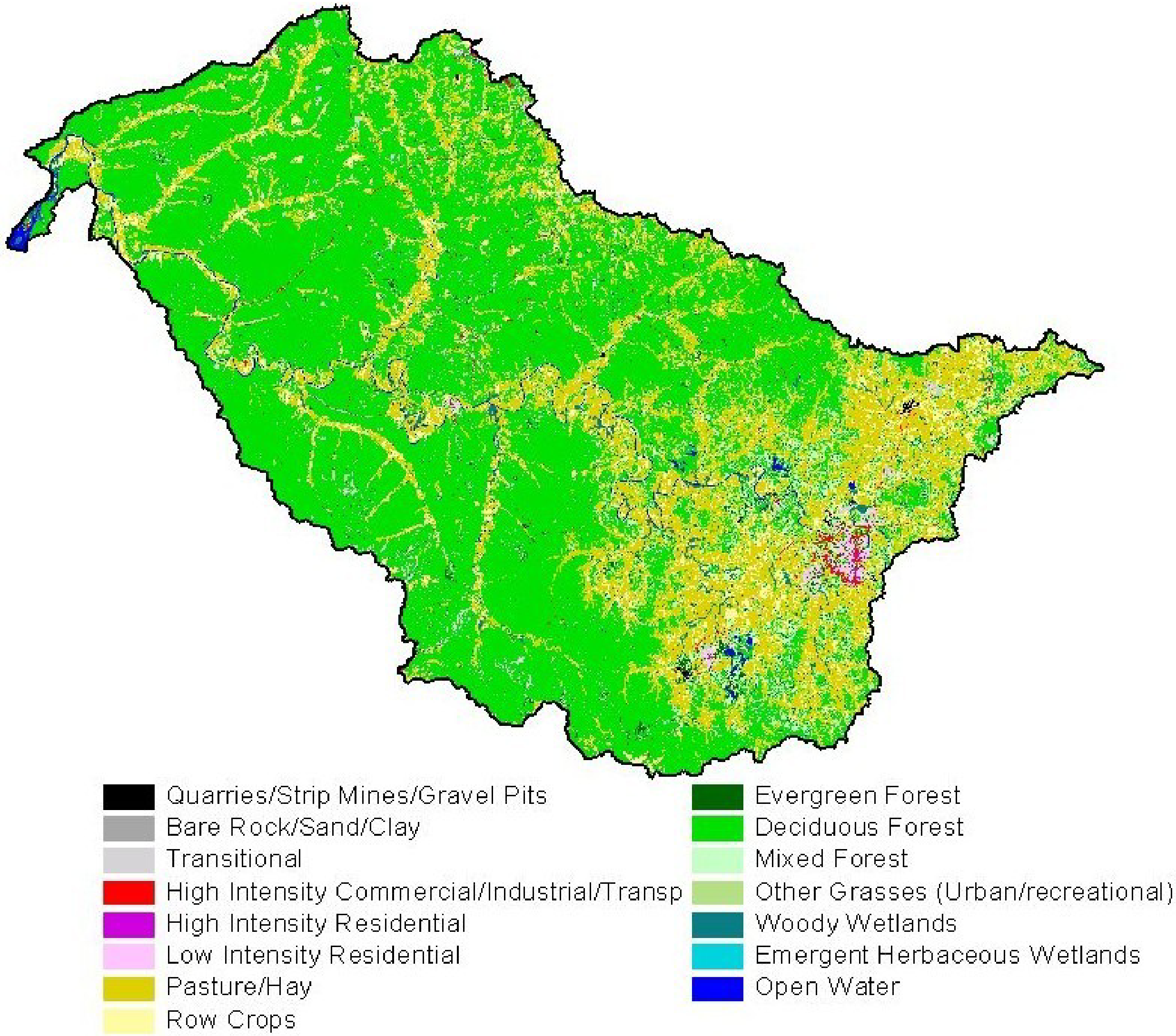


Figure 3 MRLC Land Use in the Lower Duck River Watershed



3.0 PROBLEM DEFINITION

Siltation effects impact over 4,000 miles of streams in Tennessee and is by far the most frequently cited pollutant for surface waters. Pollution due to siltation has a significant economic impact due to increased water treatment costs, loss of storage capacity in reservoirs, direct impacts to navigation, and the increased possibility of flooding (TDEC 2000).

Silt alters the physical properties of waters by:

- Restricting or preventing light penetration
- Altering temperature patterns
- Decreasing the depth of pools or lakes
- Changing flow patterns

Silt alters the chemical properties of waters by:

- Interfering with photosynthesis
- Causing an increase in sediment oxygen demand due to decomposition of organic material
- Increasing nutrient levels which can accelerate eutrophication
- Transporting organic chemicals and metals into the water column (especially if the original disturbed site was contaminated)

Silt alters the biological properties of waters by:

- Smothering eggs and nests of fish
- Piggybacking other pollutants in possibly toxic amounts or providing a reservoir of substances that may bioconcentrate in the food chain
- Clogging the gills of fish and other forms of aquatic life
- Interfering with the feeding of fish species that find food by sight
- Covering substrate that provides habitat for benthic organisms that provide food for fish
- Reducing biological integrity by altering habitats to favor burrowing species
- Accelerating the growth of submerged aquatic plants

The State of Tennessee's final 2002 303(d) list was approved by the U.S. Environmental Protection Agency (EPA), Region IV in January, 2004 (TDEC, 2004). The list identified a number of waterbodies in the Lower Duck River watershed as not fully supporting designated use classifications due, in part, to siltation and/or habitat alteration associated with agriculture, urban runoff, land development, and bank modification. These waterbodies are summarized in Table 2 and shown in Figure 4. The designated use classifications for the Lower Duck River and its tributaries include fish and aquatic life, irrigation, livestock watering & wildlife, and recreation. Some waterbodies in the watershed are also classified for industrial water supply and/or domestic water supply. These TMDLs are established to attain full support of the designated use of fish and aquatic life. This approach will also protect all other designated uses.

A description of the stream assessment process in Tennessee can be found in *2002 305(b) Report, The Status of Water Quality in Tennessee* (TDEC, 2002). This document states that "biological surveys using macroinvertebrates as the indicator organisms are the preferred method for assessing support of the fish & aquatic life designated use." The waterbody segments listed in Table 2 below were assessed as impaired based primarily on biological surveys. The results of these assessment surveys are summarized in Table 3 below. The assessment information presented is excerpted from the EPA/TDEC Assessment Database (ADB) and is referenced to the waterbody IDs in Table 2 below. ADB information may be accessed at: http://gwidc.gwi.memphis.edu/website/wpc_arcmap .

4.0 TARGET IDENTIFICATION

Several narrative criteria, applicable to siltation/habitat alteration, are established in *Rules of Tennessee Department of Environment and Conservation, Tennessee Water Quality Control Board, Division of Water Pollution Control, Chapter 1200-4-3 General Water Quality Criteria, January, 2004* (TDEC, 2004a):

Applicable to all use classifications (Fish & Aquatic Life shown):

> Solids, Floating Materials, and Deposits – There shall be no distinctly visible solids, scum, foam, oily slick, or the formation of slimes, bottom deposits or sludge banks of such size and character that may be detrimental to fish and aquatic life.
>
> Other Pollutants – The waters shall not contain other pollutants that will be detrimental to fish or aquatic life.

Applicable to the Domestic Water Supply, Industrial Water Supply, Fish & Aquatic Life, and Recreation use classifications (Fish & Aquatic Life shown):

> Turbidity or Color – There shall be no turbidity or color in such amounts or of such character that will materially affect fish and aquatic life.

Applicable to the Fish & Aquatic Life use classification:

> Biological Integrity - The waters shall not be modified through the addition of pollutants or through physical alteration to the extent that the diversity and/or productivity of aquatic biota within the receiving waters are substantially decreased or adversely affected, except as allowed under 1200-4-3-.06.
>
> Interpretation of this provision for any stream which (a) has at least 80% of the upstream catchment area contained within a single bioregion and (b) is of the appropriate stream order specified for the bioregion and (c) contains the habitat (riffle or rooted bank) specified for the bioregion, may be made using the most current revision of the Department's Quality System Standard Operating Procedure for Macroinvertebrate Stream Surveys and/or other scientifically defensible methods.

Interpretation of this provision for all other streams, plus large rivers, reservoirs, and wetlands, may be made using Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers (EPA/841-B-99-002) and/or other scientifically defensible methods. Effects to biological populations will be measured by comparisons to upstream conditions or to appropriately selected reference sites in the same bioregion if upstream conditions are determined to be degraded.

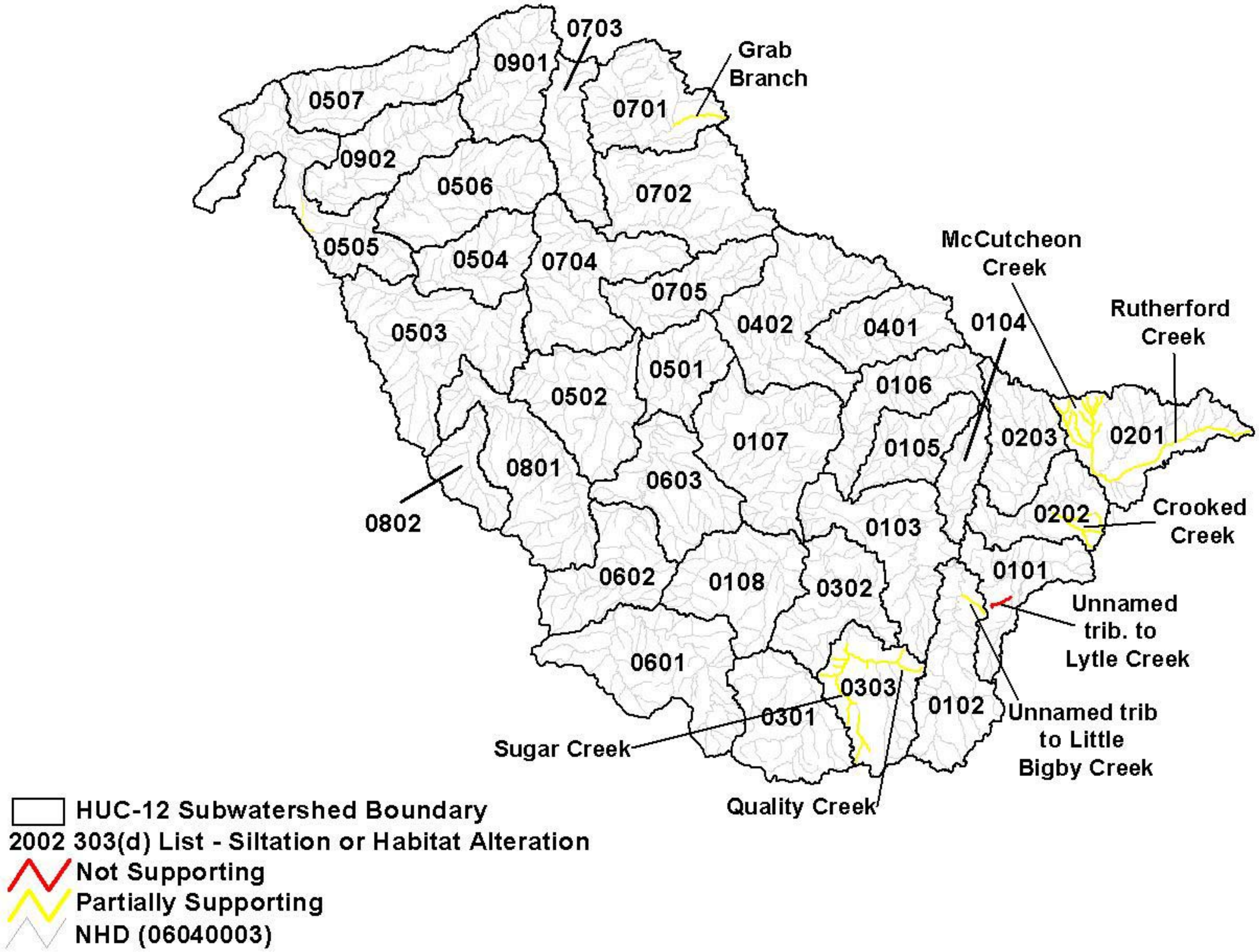
Table 2 2002 303(d) List - Stream Impairment Due to Siltation/Habitat Alteration in the Lower Duck River Watershed

Waterbody ID	Waterbody	RM Partially Supporting	RM Not Supporting	Cause (Pollutant)	Pollutant Source
06040003023_0100	Quality Creek	7.1		Siltation Other Habitat Alterations	Minor Industrial Point Source/Urban Runoff/Storm Sewers Abandoned Mining
06040003023_0200	Sugar Creek	13.6		Siltation Other Habitat Alterations	Urban Runoff/Storm Sewers/Landfills Abandoned Mining
06040003027_0100	Unnamed Trib To Little Bigby Creek	2.0		Other Habitat Alterations	Urban Runoff/Storm Sewer Channelization
06040003030_0100	Unnamed Trib To Lytle Creek		1.6	Siltation Other Habitat Alterations	Urban Runoff/Storm Sewers Channelization
06040003034_0300	Mccutcheon Creek	21.8		Siltation	Land Development Urban Runoff/Storm Sewers
06040003034_0700	Crooked Creek	2.5		Siltation Other Habitat Alterations	Pasture Grazing
06040003034_2000	Rutherford Creek	12.5		Siltation	Minor Municipal Point Source/Land Development
06040003050_0610	Grab Branch	3.9		Siltation	Pasture Grazing Urban Runoff/Storm Sewers/Industrial Permitted Runoff

Table 3 Water Quality Assessment of Waterbodies Impaired Due to Siltation/Habitat Alteration in the Lower Duck River Watershed

Waterbody ID	Waterbody	Cause (Pollutant)	Pollutant Source	Comments
06040003 023_0100	Quality Creek	Siltation Other Habitat Alterations	Minor Industrial Point Source/Urban Runoff/Storm Sewers/Abandoned Mining	TDEC ambient station at Canaan Road. E. coli elevated. Elevated nitrate-nitrite levels. 2000 TDEC biological survey at mile 8.5 (Canaan Road). 8 EPT families, 22 total families. Habitat score = 128.
06040003 023_0200	Sugar Creek	Siltation Other Habitat Alterations	Urban Runoff/Storm Sewers/Landfills/Abandoned Mining	1999 TDEC biological survey at mile 0.1 (Highway 243). 6 EPT families, 22 total families. Habitat score = 87. Grab samples at Highway 166, Clearwater Road and at Highway 243. Two observations of low DO.
06040003 027_0100	Unnamed Trib To Little Bigby Creek	Other Habitat Alterations	Urban Runoff/Storm Sewer/Channelization	1999 TDEC biological survey at miles 0.1 (Highway 243). 4 EPT families, 22 total families. Habitat score = 94.
06040003 030_0100	Unnamed Trib To Lytle Creek	Siltation Other Habitat Alterations	Urban Runoff/Storm Sewers/Channelization	TDEC biological stations at miles 0.1 & 0.8). 3 EPT families, 10 total families at mile 0.1. 1 EPT families, 10 total families at mile 0.8.
06040003 034_0300	Mccutcheon Creek	Siltation	Land Development Urban Runoff/Storm Sewers	1999 TDEC biological survey at mile 0.9 (Kedron Road). 5 EPT families, 21 total families. Habitat score = 119. Grab samples from Kedron Pike. No WQS violations noted, but no nutrient data.
06040003 034_0700	Crooked Creek	Siltation Other Habitat Alterations	Pasture Grazing	TDEC 2000 probabilistic monitoring station at mile 0.2 at Tom Lunn Road. Violated proposed biocriteria for 71i. (3 EPT genera, 11 total genera, habitat score=104). NCBI score=7.26
06040003 034_2000	Rutherford Creek	Siltation	Minor Municipal Point Source/Land Development	1999 TDEC biological survey at mile 19.3 (Kedron Road) 5 EPT families, 17 total families. Habitat score = 111.
06040003 050_0610	Grab Branch	Siltation	Pasture Grazing Urban Runoff/Storm Sewers/Ind Permitted Runoff	1999 TDEC biological survey at mile 1.3 (Cowan Road). 6 EPT families, 19 total families. Habitat score = 122.

Figure 4 Waterbodies Impaired Due to Siltation/Habitat Alteration - 2002 303(d) List



> Habitat - The quality of instream habitat shall provide for the development of a diverse aquatic community that meets regionally based biological integrity goals. The instream habitat within each subecoregion shall be generally similar to that found at reference streams. However, streams shall not be assessed as impacted by habitat loss if it has been demonstrated that the biological integrity goal has been met.

These TMDLs are being established to attain full support of the fish and aquatic life designated use classification. TMDLs established to protect fish and aquatic life will protect all other use classifications for the identified waterbodies from adverse alteration due to sediment loading.

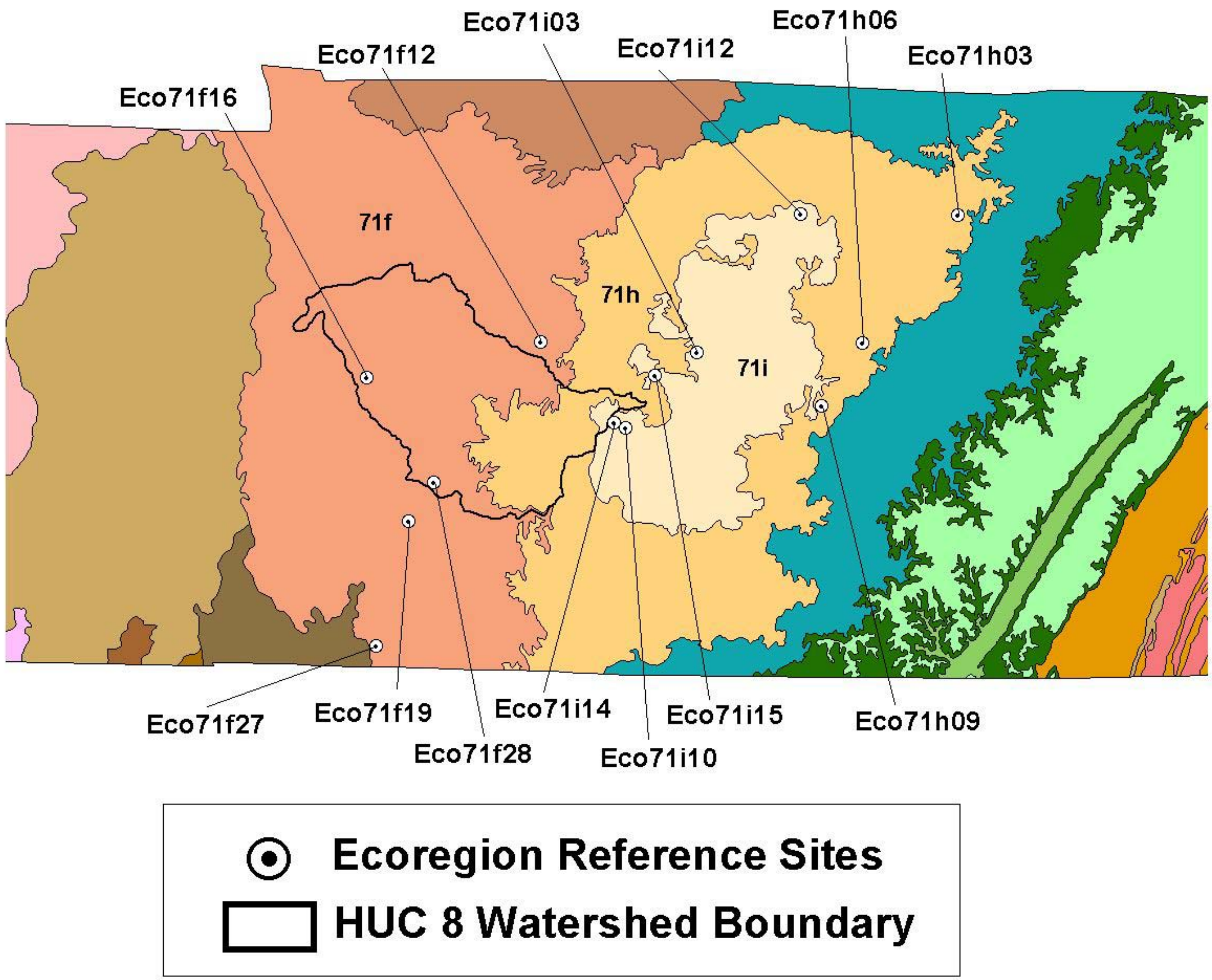
In order for a TMDL to be established, a numeric "target" protective of the uses of the water must be identified to serve as the basis for the TMDL. Where State regulation provides a numeric water quality criteria for the pollutant, the criteria is the basis for the TMDL. Where State regulation does not provide a numeric water quality criteria, as in the case of siltation/habitat alteration, a numeric interpretation of the narrative water quality standard must be determined. For the purpose of these TMDLs, the average annual sediment loading in lbs/acre/yr, from a biologically healthy watershed, located within the same Level IV ecoregion as the impaired watershed, is determined to be the appropriate numeric interpretation of the narrative water quality standard for protection of fish and aquatic life. Biologically healthy watersheds were identified from the State's ecoregion reference sites. These ecoregion reference sites have similar characteristics and conditions as the majority of streams within that ecoregion. Detailed information regarding Tennessee ecoregion reference sites can be found in *Tennessee Ecoregion Project, 1994-1999* (TDEC 2000a). In general, land use in ecoregion reference watersheds contain less pasture, cropland, and urban areas, and more forested areas compared to the impaired watersheds. The biologically healthy (reference) watersheds are considered the "least impacted" in an ecoregion and, as such, sediment loading from these watersheds may serve as an appropriate target for the TMDL.

Using the methodology described in Appendix A, the Watershed Characterization System (WCS) Sediment Tool was used to calculate the average annual sediment load for each of the biologically healthy (reference) watersheds in Level IV ecoregions 71f, 71h and 71i. The geometric mean of the average annual sediment loads of the reference watersheds in each Level IV ecoregion was selected as the most appropriate target for that ecoregion. Since the impairment of biological integrity due to sediment build-up is generally a long-term process, using an average annual load was considered appropriate. The average annual sediment loads for reference sites and corresponding TMDL target values for Level IV ecoregions 71f, 71h and 71i are summarized in Table 4. Reference site locations are shown in Figure 5.

Table 4 Average Annual Sediment Loads of Level IV Ecoregion Reference Sites

Level IV Ecoregion	Reference Site	Stream	Drainage Area (acres)	Average Annual Sediment Load [lbs/ac/yr]
71f	Eco71f12	S Harpeth Creek	6748	1249.3
	Eco71f16	Wolf Creek	9883	249.7
	Eco71f19	Brush Creek	8169	794.0
	Eco71f27	Swanegan Branch	3204	767.5
	Eco71f28	Little Swan Creek	5562	211.3
	Geometric Mean (Target Load)			**525.8**
71h	Eco71h03	Flynn Creek	8,316	735.7
	Eco71h06	Clear Fork Creek	8,782	559.3
	Eco71h09	Carson Fork	7,937	518.6
	Geometric Mean (Target Load)			**597.6**
71i	Eco71i03	Stewart Creek	15298	123.9
	Eco71i10	Flat Creek	12206	512.0
	Eco71i12	Cedar Creek	17856	449.4
	Eco71i14	Little Flat Creek	4280	430.9
	Eco71i15	Harpeth River	43260	446.7
	Geometric Mean (Target Load)			**392.6**

Figure 5 Reference Sites in Level IV Ecoregions 71f, 71h & 71i



Note: Ecoregion reference sites are continually reviewed, with sites added or deleted as circumstances warrant. The stations shown were determined as ecoregion reference sites as of June 3, 2003.

5.0 WATER QUALITY ASSESSMENT AND DEVIATION FROM TARGET

Using the methodology described in Appendix A, the WCS Sediment Tool was used to determine the average annual sediment load for all HUC-12 subwatersheds in the Lower Duck River watershed (Figure 6). The estimated existing average annual loads for subwatersheds with waterbodies listed on the 2002 303(d) List as impaired for siltation/habitat alteration are summarized in Table 5.

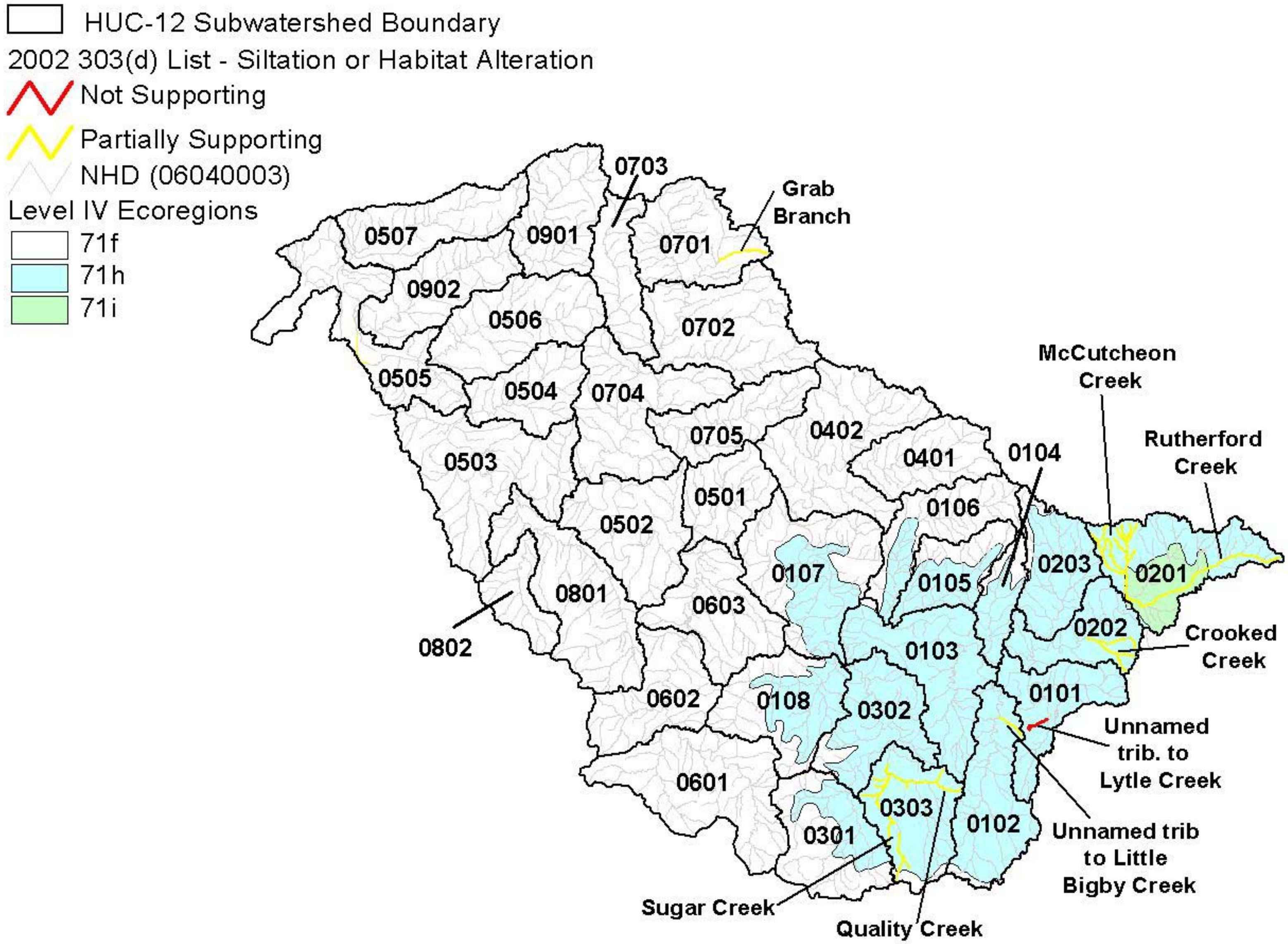
Table 5 Existing Sediment Loads in Subwatersheds With Impaired Waterbodies

Huc-12 Subwatershed (06040003____)	Level IV Ecoregion	Existing Sediment Load [lbs/ac/yr]
0101	71h	1127
0102	71h	888
0201	71h/i	885
0202	71h	940
0303	71h	679
0701	71f	1165

6.0 SOURCE ASSESSMENT

An important part of the TMDL analysis is the identification of individual sources, source categories, or source subcategories of siltation in the watershed and the amount of pollutant loading contributed by each of these sources. Under the Clean Water Act, sources are broadly classified as either point or nonpoint sources. Under 40 CFR 122.2, a point source is defined as a discernable, confined, and discrete conveyance from which pollutants are or may be discharged to surface waters. The National Pollutant Discharge Elimination System (NPDES) program regulates point source discharges. Regulated point sources include: 1) municipal and industrial wastewater treatment facilities (WWTFs); 2) storm water discharges associated with industrial activity (which includes construction activities); and 3) certain discharges from Municipal Separate Storm Sewer Systems (MS4s). A TMDL must provide Waste Load Allocations (WLAs) for all NPDES-regulated point sources. For the purposes of these TMDLs, all sources of sediment loading not regulated by NPDES are considered nonpoint sources. The TMDL must provide a Load Allocation (LA) for these sources.

Figure 6 Lower Duck River Watershed – HUC-12 Subwatershed Boundaries



6.1 Point Sources

6.1.1 NPDES-Regulated Municipal and Industrial Wastewater Treatment Facilities

Discharges from WWTFs may contribute sediment to receiving waters as Total Suspended Solids (TSS) and/or turbidity. Of the sixteen facilities with NPDES permits that require monitoring of TSS or turbidity in the Lower Duck River watershed (see Figure 7), seven are located in impaired HUC-12 subwatersheds. Permit limits for these discharges are summarized in Table 5. Sediment discharges from WWTFs in impaired subwatersheds are small in relation to sediment loading caused by storm water runoff (see Appendix D). The TSS component of WWTF discharges is generally composed more of organic material and, therefore, provides less direct impact to the biological integrity of the stream (through settling and accumulation) than would stream sedimentation due to soil erosion.

6.1.2 NPDES Regulated Ready Mixed Concrete Facilities

Discharges from regulated Ready Mixed Concrete Facilities (RMCFs) may contribute sediment to surface waters as TSS. Most of these facilities obtain coverage under NPDES Permit No. TNG110000, *General NPDES Permit for Discharges of Storm Water Runoff and Process Wastewater Associated With Ready Mixed Concrete Facilities*. This permit establishes a daily maximum TSS concentration limit of 50 mg/l on process wastewater effluent and specifies monitoring procedures for storm water discharges. Facilities are also required to develop and implement storm water pollution prevention plans (SWPPPs). Discharges from RMCFs are generally intermittent, and contribute a small portion of total sediment loading to HUC-12 subwatersheds (see Appendix D). In some cases, for discharges into 303(d) listed waters, sites may be required to obtain coverage under an individual NPDES permit. There are nine permitted RMCFs in the Lower Duck River watershed, five of which are located in impaired subwatersheds. These facilities are listed in Table 6 and shown in Figure 7.

6.1.3 NPDES Regulated Mining Sites

Discharges from regulated mining activities may also contribute sediment to surface waters as TSS. Discharges from active mines may result from dewatering operations and/or in response to storm events, whereas discharges from permitted inactive mines are only in response to storm events. Inactive sites with successful surface reclamation contribute relatively little solids loading. The one permitted mining site in the Lower Duck River Watershed is shown in Figure 7 and summarized in Table 7. The mine is located in an impaired subwatershed. Sediment loads (as TSS) to waterbodies from mining site discharges are negligible in relation to total sediment loading (see Appendix D).

Figure 7 NPDES Facilities Permitted to Discharge TSS in the Lower Duck River Watershed

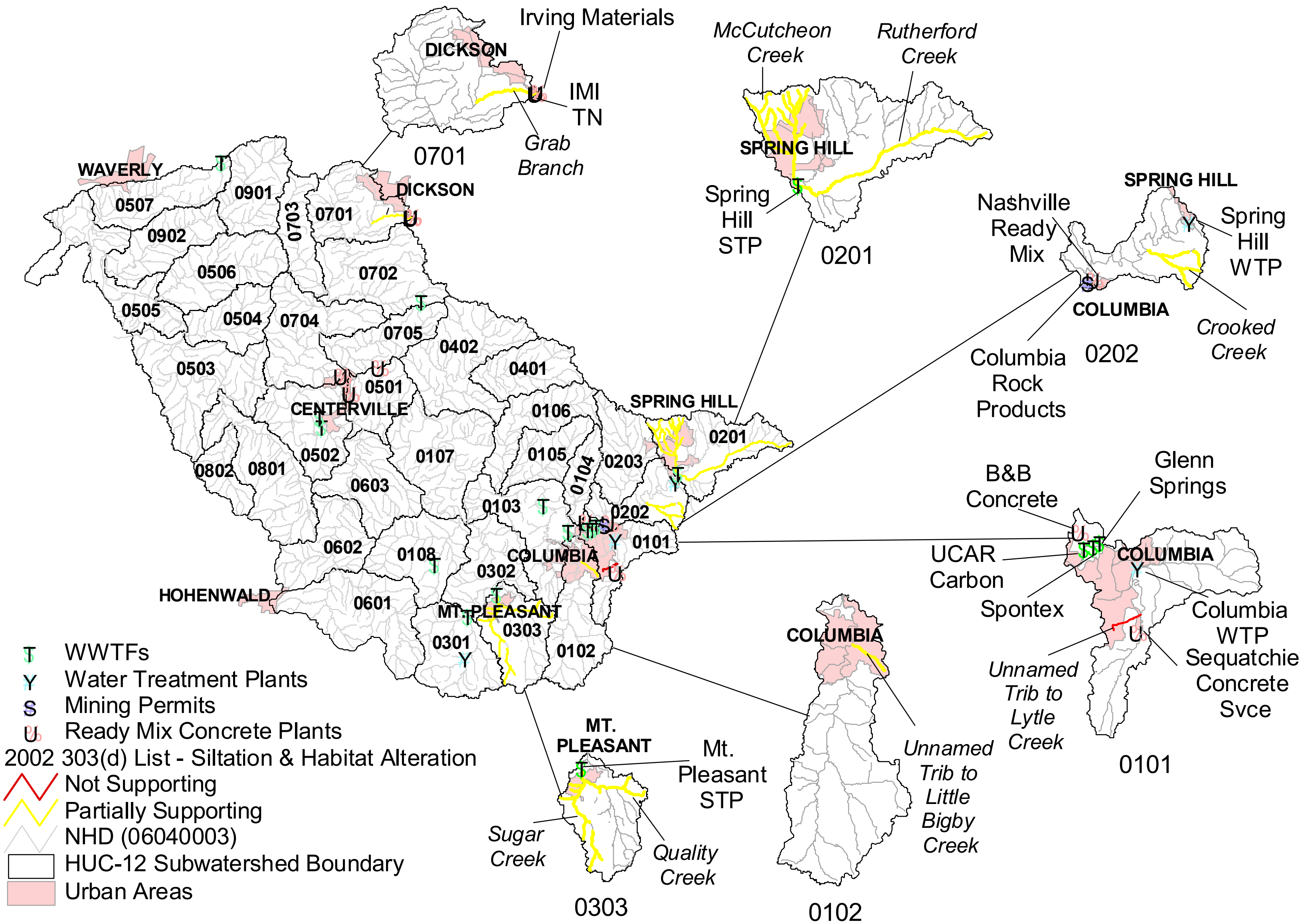


Table 6 WWTFs Permitted to Discharge TSS in the Lower Duck River Watershed

Sub-watershed	Sub-watershed Area	NPDES Permit No.	Facility	Design Flow	NPDES Permit Limit - TSS				
					Monthly Average		Weekly Average		Daily Maximum
	[acres]			[MGD]	[mg/l]	[lbs/day]	[mg/l]	[lbs/day]	[mg/l]
0101 [a]	21782.3	TN0001571	Spontex Inc.	0.2602	30	229	---	---	45
0101 [a]	21782.3	TN0004375	Columbia Water System WTP	[b]	---	---	---	---	40
0101 [a]	21782.3	TN0002275	UCAR Carbon Company Inc., Outfall 001	0.6645	40	---	---	---	70
0101 [a]	21782.3	TN0002275	UCAR Carbon Company Inc., Outfall 002	0	50	---	---	---	70
0101 [a]	21782.3	TN0002275	UCAR Carbon Company Inc., Outfall 003	0.0146	30	---	---	---	45
0101 [a]	21782.3	TN0026441	Glenn Springs Holdings, Inc., Outfall 001	0.547	15	---	---	---	30
0101 [a]	21782.3	TN0026441	Glenn Springs Holdings, Inc., Outfall 002 [c]	0.006	55	---	---	---	110
0103	35206.0	TN0001538	Solutia, Inc.	0.99	40	---	---	---	79
0103	35206.0	TN0056103	Columbia STP	14	30	1751	40	2335	45
0108	30410.8	TN0060291	Hampshire Coin Laundry	0.00051	---	---	---	---	40
0201 [a]	32395.8	TN0075868	Spring Hill STP	2	30	500	40	667	45
0202 [a]	19670.8	TN0077933	Spring Hill WTP	0.296	---	---	---	---	40
0301	30079.0	TN0061689	Mount Pleasant WTP	1.29	---	---	---	---	40
0301	30079.0	TN0067415	CYTEC Industries, Inc.	0.086	---	37.7	---	115.1	40
0303 [a]	26289.4	TN0020800	Mount Pleasant STP	0.71	30	178	40	237	45
0502	31664.6	TN0021962	Universal Fasteners, Inc. #1	0.12	31	---	---	---	60
0502	31664.6	TN0024937	Centerville STP	00.75	30	188	40	250	45
0507	26588.2	TN0021741	McEwen STP	0.45	30	113	40	150	45
0705	21700.2	TN0067130	East Hickman Co. Middle School	0.031	30	---	---	---	45

[a] Subwatershed with waterbodies listed as impaired due to siltation/habitat alteration.
[b] Zero discharge, land applied through a spray field application on CWS property
[c] Storm water runoff from ore settling pond, 0.006 MGD Long-term average (2.2 MGY)

Table 7 NPDES Regulated Ready Mixed Concrete Facilities in the Lower Duck River Watershed

HUC-12 Subwatershed	NPDES Permit No.	Facility Name	Area	TSS Daily Maximum Limit
			[acres]	[mg/l]
0101 [a]	TNG110120	Sequatchie Concrete Service, Inc.	6.0	50
0101 [a]	TNG110241	B & B Concrete Products, Inc.	3.5	50
0103	TNG110068	I.M.I. Tennessee, Inc.	2.5	50
0202 [a]	TNG110055	Nashville Ready Mix of Columbia	5.14	50
0203	TNG110067	I.M.I. Tennessee, Inc.	4.5	50
0601	TNG110004	V & W Ready Mix Concrete Co., Inc.	1.8	50
0701 [a]	TNG110205	Nashville Ready Mix of Dickson	2.61	50
0701 [a]	TNG110235	I.M.I. Tennessee, Inc.	7.42	50
0704	TNG110221	V & W Ready Mix Concrete Co., Inc.	[b]	50

[a] Subwatershed with waterbodies listed as impaired due to siltation/habitat alteration
[b] No data

Table 8 NPDES Regulated Mining Site in the Lower Duck River Watershed

HUC-12 Subwatershed	NPDES Permit No.	Name	Area	TSS Daily Maximum Limit	Status
			[acres]	[mg/l]	
0202 [a]	TN0004171	Columbia Rock Products Corporation	40	40	Active

[a] Subwatershed with waterbodies listed as impaired due to siltation/habitat alteration.

6.1.4 Aquatic Resource Alteration

There are a number of stream alteration activities that have the potential to effect sediment loading to surface waters in the Lower Duck River Watershed. In Tennessee, Aquatic Resource Alteration Permits (ARAPs) are required for any alteration of state waters not requiring a federal permit, including:

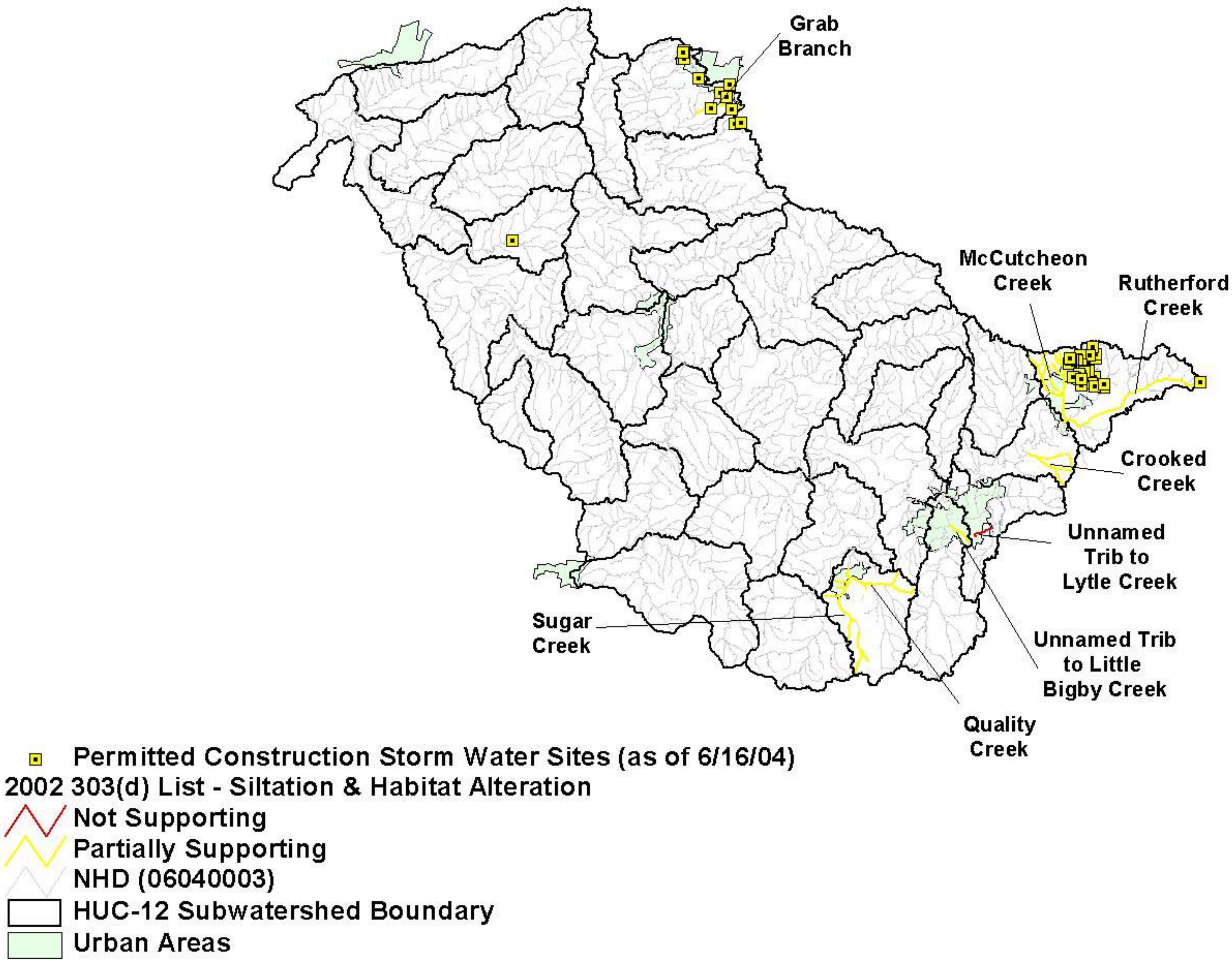
- Dredging, widening, straightening, or bank stabilization
- Levee construction (if excavation or fill of stream channel is involved)
- Channel relocation
- Flooding, excavating, draining, and/or filling a wetland
- Bridge construction
- Bridge scour repair
- Construction of road or utility line crossings
- Sand and gravel dredging
- Debris removal
- Emergency road repair

Aquatic Resource Alteration Permits are developed in accordance with Tennessee Rule 1200-4-7, *Aquatic Resource Alteration* (TDEC, 2000b) and contain provisions that minimize impacts to surface waters.

6.1.5 NPDES-Regulated Construction Activities

Discharges from NPDES-regulated construction activities are considered point sources of sediment loading to surface waters and occur in response to storm events. Currently, discharges of storm water from construction activities disturbing an area of one acre or more must be authorized by an NPDES permit. Most of these construction sites obtain coverage under NPDES Permit No. TNR10-0000, *General NPDES Permit for Storm Water Discharges Associated With Construction Activity*. The permit requires the development and implementation of a SWPPP to minimize the discharge of pollutants to surface waters and prohibits discharges that would result in the violation of a State water quality criteria. Additional requirements are specified for discharges into 303(d) listed waters, and, in some cases, sites may be required to obtain coverage under an individual NPDES permit. Since construction activities at a site are of a temporary, relatively short-term nature, the number of construction sites covered by the general permit at any instant of time varies. In the Lower Duck River watershed, there were 42 permitted active construction sites on June 16, 2004 (See Figure 8).

Figure 8 Location of NPDES Permitted Construction Sites in the Lower Duck River Watershed



6.1.6 NPDES-Regulated Municipal Separate Storm Sewer Systems

MS4s may also discharge sediment to waterbodies in response to storm events through road drainage systems, curb and gutter systems, ditches, and storm drains. These systems convey urban runoff from surfaces such as bare soil and washoff of accumulated street dust and litter from impervious surfaces during rain events. Large and medium MS4s serving populations greater than 100,000 people are required to obtain a NPDES storm water permit. At present, there are no MS4s of this size in the Lower Duck River Watershed. As of March 2003, small MS4s serving urbanized areas, or having the potential to exceed instream water quality standards, are required to obtain a permit under the NPDES General Permit for Discharges from Small Municipal Separate Storm Sewer Systems (TDEC, 2002). An urbanized area is defined as an entity with a residential population of at least 50,000 people and an overall population density of 1,000 people per square mile. The City of Columbia is covered under Phase II of the NPDES Storm Water Program (NPDES Permit TNS075248, issued July 3, 2003, effective July 7, 2003 and expires February 26, 2008). The Tennessee Department of Transportation (TDOT) is also being issued as MS4 permit (TNS077585, target public notice 7/5/2004) for State roads in urban areas. The federal guidance for Phase 1 Municipal Separate Storm Sewer Systems shall apply as well as the Amended Consent Order and Agreement between TDOT and the Division of Water Pollution Control dated March 10, 2004. Information regarding storm water permitting in Tennessee may be obtained from the TDEC website at:
http://www.state.tn.us/environment/wpc/stormh2o/ .

6.2 Nonpoint Sources

Nonpoint sources account for the vast majority of sediment loading to surface waters. These sources include:

- Natural erosion occurring from the weathering of soils, rocks, and uncultivated land; geological abrasion; and other natural phenomena.
- Erosion from agricultural activities can be a major source of sedimentation due to the large land area involved and the land-disturbing effects of cultivation. Grazing livestock can leave areas of ground with little vegetative cover. Unconfined animals with direct access to streams can cause streambank damage.
- Urban erosion from bare soil areas under construction and washoff of accumulated street dust and litter from impervious surfaces.
- Erosion from unpaved roadways can be a significant source of sediment to rivers and streams. It occurs when soil particles are loosened and carried away from the roadway, ditch, or road bank by water, wind, or traffic. The actual road construction (including erosive road-fill soil types, shape and size of coarse surface aggregate, poor subsurface and/or surface drainage, poor road bed construction, roadway shape, and inadequate runoff discharge outlets or “turn-outs” from the roadway) may aggravate roadway erosion. In addition, external factors such as roadway shading and light exposure, traffic patterns, and road maintenance may also affect roadway erosion. Exposed soils, high runoff velocities and volumes, and poor road compaction all increase the potential for erosion.

- Runoff from abandoned mines may be significant sources of solids loading. Mining activities typically involve removal of vegetation, displacement of soils and other significant land disturbing activities.

- Soil erosion from forested land that occurs during timber harvesting and reforestation activities. Timber harvesting includes the layout of access roads, log decks, and skid trails; the construction and stabilization of these areas; and the cutting of trees. Established forest areas produce very little soil erosion.

For the listed waterbodies within the Lower Duck River Watershed, the primary sources of nonpoint sediment loads come from agriculture, roadways, and urban sources.

7.0 DEVELOPMENT OF TOTAL MAXIMUM DAILY LOAD

The TMDL process quantifies the amount of a pollutant that can be assimilated in a waterbody, identifies the sources of the pollutant, and recommends regulatory or other actions to be taken to achieve compliance with applicable water quality standards based on the relationship between pollution sources and in-stream water quality conditions. A TMDL can be expressed as the sum of all point source loads (Waste Load Allocations), non-point source loads (Load Allocations), and an appropriate margin of safety (MOS) which takes into account any uncertainty concerning the relationship between effluent limitations and water quality:

$$\text{TMDL} = \Sigma \text{ WLAs} + \Sigma \text{ LAs} + \text{MOS}$$

The objective of a TMDL is to allocate loads among all of the known pollutant sources throughout a watershed so that appropriate control measures can be implemented and water quality standards achieved. 40 CFR §130.2 (i) states that TMDLs can be expressed in terms of mass per time, toxicity, or other appropriate measure.

TMDL analyses are performed on a 12-digit hydrologic unit area (HUC-12) basis for subwatersheds containing waterbodies identified as impaired due to siltation or habitat alteration on the 2002 303(d) list. HUC-12 subwatershed boundaries are shown in Figure 6.

7.1 Analysis Methodology

Sediment analysis for watersheds can be conducted using methods ranging from simple, gross estimates to complex dynamic loading and receiving water models. The choice of methodology is dependent on a number of factors that include: watershed size, type of impairment, type and quantity of data available, resources available, time, and cost. In consideration of these factors, the following approach was selected as the most appropriate for first phase sediment TMDLs in the Lower Duck River watershed:

- The Watershed Characterization System (WCS) Sediment Tool was used to determine sediment loading to Level IV ecoregion reference site watersheds. These are considered to be biologically healthy watersheds. The average annual sediment loads in lbs/acre/yr of these reference watersheds serve as target values for the Lower Duck River watershed sediment TMDLs.

- The Sediment Tool was also used to determine the existing average annual sediment loads of impaired watersheds located in the same Level IV ecoregion. Impaired watersheds are defined as 12-digit HUCs containing one or more waterbodies identified as impaired due to siltation/habitat alteration on the State's 2002 303(d) List (ref: Figure 3).

- The existing average annual sediment load of each impaired HUC-12 subwatershed was compared to the average annual load of the appropriate reference (biologically healthy) watershed and an overall required percent reduction in loading calculated. In each impaired HUC-12 subwatershed, the TMDL is equal to this overall required reduction.

$$\text{TMDL} = \frac{(\text{Existing Load}) - (\text{Target Load})}{(\text{Existing Load})} \times 100$$

  Although the Sediment Tool uses the best road, elevation, and land use GIS coverages available, the resulting average annual sediment loads should not be interpreted as an absolute value. The calculated loading reductions, however, are considered to be valid since they are based on the relative comparison of loads calculated using the same methodology.

- Five percent of the ecoregion-based target load was reserved to account for WLAs for NPDES permitted WWTFs, mining sites, RMCFs, and permitted aquatic resource alteration activities The existing loads from these facilities were determined to be less than the five percent reserved in each impaired HUC-12 subwatershed. Any difference between these existing loads and the 5% reserved load provide for future growth and additional MOS (see Appendix D).

- For each impaired HUC-12 subwatershed, WLAs for construction storm water sites, WLAs for MS4s, and LAs for nonpoint sources were considered to be the percent load reduction required to decrease the existing annual average sediment load must to a level equal to 95% of the target value.

$$\text{WLA}_{\text{Const.SW}} = \text{WLA}_{\text{MS4}} = \text{LA} = \frac{(\text{Existing Load}) - [(.95)\ (\text{Target Load})]}{(\text{Existing Load})} \times 100$$

- TMDLs, WLAs for construction storm water sites and MS4s, and LAs are expressed as a percent reduction in average annual sediment loading. WLAs for WWTFs, mining sites, and RMCFs are equal to loads authorized by their existing permits. Since sediment loading from WWTFs, mining sites, and RMCFs are small with respect to storm water induced sediment loading, further reductions from these facilities was not considered warranted (ref.: Appendix D). The reduction of sediment loading, as specified byTMDLs, in impaired watersheds will result in the attainment of fully supporting status for all designated use classifications, with respect to siltation/habitat alteration. According to 40 CFR §130.2 (i), TMDLs can be expressed in terms of mass per time, toxicity, or other appropriate measure.

Details of the analysis methodology are more fully described in Appendix A. This approach is recognized as an acceptable alternative to a maximum allowable mass load per day in the *Protocol for Developing Sediment TMDLs* (USEPA, 1999). Target loading and sediment TMDLs for subwatersheds containing waterbodies identified as impaired for siltation/habitat alteration are summarized in Table 9.

Table 9 Sediment TMDLs for Subwatersheds with Waterbodies Impaired for Siltation/Habitat Alteration

HUC-12 SubWS	Waterbody ID	Waterbody Impaired by Siltation/ Habitat Alteration	Level IV Ecoregion	Existing Sediment Load [a]	Target Load [b]	TMDL (Required Overall Load Reduction)
				[lbs/ac/yr]	[lbs/ac/yr]	[%]
0101	06040003030_0100	Unnamed Tributary To Lytle Creek	71h	1127	597.6	47.0
0102	06040003027_0100	Unnamed Tributary To Little Bigby Creek	71h	888	597.6	32.7
0201	06040003034_0300	McCutcheon Creek	71h	885	597.6	32.5
	06040003034_2000	Rutherford Creek				
0202	06040003034_0700	Crooked Creek	71h	940	597.6	36.4
0303	06040003023_0100	Quality Creek	71h	679	597.6	12.0
	06040003023_0200	Sugar Creek				
0701	06040003050_0610	Grab Branch	71f	1165	525.8	54.9

[a] From Table 5 above [b] From Table 4 above

7.2 Waste Load Allocations

7.2.1 Waste Load Allocations for NPDES-Regulated Municipal and Industrial Wastewater Treatment Facilities

There are a total of sixteen facilities in the Lower Duck River Watershed with individual NPDES permits that require monitoring of TSS or turbidity. Glenn Springs Holdings, Inc. has two outfalls with TSS limits and UCAR Carbon Company Inc. has three outfalls with TSS limits. Seven of these facilities are located in subwatersheds with waterbodies identified as impaired due to siltation/habitat alteration on 2002 303(d) List. WLAs for TSS are provided for each outfall of these facilities at a level equal to their existing permit limits (see Table 10) except for Outfall 2 of Glenn Springs Holdings, Inc. (calculated for ore settling pond overflow, see Appendix D). It is considered appropriate to provide these facilities their current discharge levels of TSS since the sediment loading from these facilities is small compared to other sources (see Appendix D). In addition, sediment loads from WWTFs are generally composed more of organic material and, therefore, provide less direct impact to biological integrity (through settling and accumulation) than would direct soil loss to the streams.

Table 10 WLAs for NPDES Permitted Wastewater Treatment Facilities

HUC-12 Sub-WS	NPDES Permit No.	Facility	WLA (as TSS)	
			Flow	Monthly Average Permit Limit
			[MGD]	[mg/L]
0101	TN0001571	Spontex Inc.	0.2602	30
0101	TN0002275	UCAR Carbon Company Inc., Outfall 001	0.6645	40
0101	TN0002275	UCAR Carbon Company Inc., Outfall 002	0	50
0101	TN0002275	UCAR Carbon Company Inc., Outfall 003	0.0146	30
0101	TN0004375	Columbia Water System WTP	[a]	40 [b]
0101	TN0026441	Glenn Springs Holdings, Inc., Outfall 001	0.547	15
0101	TN0026441	Glenn Springs Holdings, Inc., Outfall 002	0.006 [c]	55
0201	TN0075868	Spring Hill STP	2	30
0202	TN0077933	Spring Hill WTP	0.296	40 [b]
0303	TN0020800	Mount Pleasant STP	0.71	30

[a] Zero discharge, land applied through a spray field application on CWS property

[b] Daily Maximum Limit [mg/L]

[c] Storm water runoff from ore settling pond, 0.006 MGD Long-term average (2.2 MGY)

7.2.2 Waste Load Allocations for NPDES Regulated Ready Mixed Concrete Facilities

There are nine Ready Mixed Concrete Facilities (RMCFs) in the Lower Duck River Watershed with NPDES permits. Five of these are located in impaired subwatersheds (ref: Table 7). Since sediment loading from the RMCFs located in impaired subwatersheds is small compared to other sources (see Appendix D), the WLA is considered to be equal to the existing permit requirements for these facilities.

7.2.3 Waste Load Allocations for NPDES-Regulated Mining Activities

There is one mining site in the Lower Duck River Watershed with an NPDES permit and it is located in an impaired subwatershed (ref: Table 8). This site is a limestone quarry. Since sediment loading from mine sites is small (see Appendix D) compared to the total loading for impaired subwatersheds, the WLA is considered to be equal to the existing permit requirement for this site.

7.2.4 Waste Load Allocations for Permitted Aquatic Resource Alteration Activities

Due to the wide range of stream alterations authorized by Aquatic Resource Alteration Permits and the transient nature of these activities, it is difficult to numerically quantify these potential sources of loading. Projects performed in accordance with ARAPs, however, are regarded as minor sources of sediment loading when compared to other sources. WLAs for these activities are considered to be equal to the requirements of the ARAP and included in the 5% of the TMDL reserved in each impaired subwatershed for minor point sources of sediment loading.

7.2.5 Waste Load Allocations for NPDES-Regulated Construction Activities

Construction activities disturbing one or more acres are regulated by the State's NPDES program (ref.: Section 6.1.5) and discharges from these sites must be authorized by a permit. This includes clearing, grading or excavating that results in an area of disturbance of one or more acres, and activities that result in the disturbance of less than one acre if it is part of a larger common plan of development or sale. Since these construction activities may discharge sediment to surface waters, WLAs are provided for this category of activities. WLAs are established for each subwatershed containing a waterbody identified on the 2002 303(d) List as impaired due to siltation or habitat alteration (ref.: Table 2). WLAs are expressed as the required percent reduction in the estimated average annual sediment loading for the impaired subwatershed, relative to the estimated average annual sediment loading (minus 5%) of a biologically healthy (reference) subwatershed located in the same Level IV ecoregion (see Table 11).

The WLAs provided to the NPDES regulated construction activities will be implemented as Best Management Practices (BMPs), as specified in NPDES Permit No. TNR10-0000, *General NPDES Permit for Storm Water Discharges Associated With Construction Activit*y. It is not technically feasible to incorporate numeric sediment limits into construction storm water permits at this time. WLAs should <u>not</u> be construed as numeric permit limits. Ambient monitoring may be required for specific discharges to determine compliance with the TMDL for a particular segment. Properly designed and well-maintained BMPs are expected to provide attainment of WLAs. In some cases, it may be necessary to go beyond standard practices in the application of BMPs to assure compliance with the WLA (see Section 8).

7.2.6 Waste Load Allocations for NPDES-Regulated Municipal Separate Storm Sewer Systems (MS4s)

Municipal separate storm sewer systems (MS4s) are regulated by the State's NPDES program (see Section 6.1.6). Since MS4s have the potential to discharge TSS to surface waters, WLAs are specified for these systems. WLAs are established for each HUC-12 subwatershed containing a waterbody identified on the 2002 303(d) List as impaired due to siltation or habitat alteration (ref. Table 2). WLAs are expressed as the required percent reduction in the estimated average annual sediment loading for an impaired subwatershed, relative to the estimated average annual sediment loading (minus 5%) of a biologically healthy (reference) subwatershed located in the same Level IV ecoregion (see Table 11).

WLAs provided to NPDES regulated MS4s will be implemented as Best Management Practices (BMPs) as specified in Phase I & II MS4 permits. It is not technically feasible to incorporate numeric sediment limits into MS4 permits at this time. WLAs should not be construed as numeric permit limits. Ambient monitoring may be required for specific discharges to determine compliance with the TMDL for a particular segment. Properly designed and well-maintained BMPs are expected to provide attainment of WLAs. In some cases, it may be necessary to go beyond standard practices in the application of BMPs to assure compliance with the WLA (see Section 8).

7.3 Load Allocations for Nonpoint Sources

All sources of sediment loading to surface waters not covered by the NPDES program are provided a Load Allocation (LA) in these TMDLs. LAs are established for each HUC-12 subwatershed containing a waterbody identified on the 2002 303(d) List as impaired due to siltation or habitat alteration (ref. Table 2). LAs are expressed as the required percent reduction in the estimated average annual sediment loading for the impaired subwatershed, relative to the estimated average annual sediment loading (minus 5%) of a biologically healthy (reference) subwatershed located in the same Level IV ecoregion (see Table 11). Properly designed and well-maintained BMPs will be necessary to assure that LAs are achieved.

Table 11 Summary of WLAs for Construction Storm Water Sites, WLAs for MS4s, & LAs for Nonpoint Sources

HUC-12 Subwatershed (06040003__)	Level IV Ecoregion	Existing Sediment Load	95% of Target Load	% Reduction – Avg. Annual Sediment Load	
				WLAs (Construction SW & MS4s)	LAs (Nonpoint Sources)
		[lb/ac/yr]	[lb/ac/yr]	[%]	[%]
0101	71h	1127	567.7	49.6	49.6
0102	71h	888	567.7	36.1	36.1
0201	71h	885	567.7	35.9	35.9
0202	71h	940	567.7	39.6	39.6
0303	71h	679	567.7	16.4	16.4
0701	71f	1165	499.5	57.1	57.1

7.4 Margin of Safety

There are two methods for incorporating a Margin of Safety (MOS) in the analysis: a) implicitly incorporate the MOS using conservative model assumptions to develop allocations; or b) explicitly specify a portion of the TMDL as the MOS and use the remainder for allocations. In these TMDLs, an implicit MOS was incorporated through the use of conservative modeling assumptions. These include:

- Target values based on Level IV ecoregion reference sites. These sites represent the least impacted streams in the ecoregion.

- The use of appropriate ecoregion reference site average annual sediment load as the target value for the calculation of load reductions.

- The use of the sediment delivery process that results in the most sediment transport to surface waters (Method 2 in Appendix A).

In most presently impaired subwatersheds, some amount of explicit MOS is realized due to the WLAs specified for NPDES permitted WWTFs, mining sites and RMCFs being less than the 5% of the target load reserved for these facilities.

7.5 Seasonal Variation

Sediment loading is expected to fluctuate according to the amount and distribution of rainfall. The determination of sediment loads on an average annual basis accounts for these differences through the rainfall erosivity index in the USLE (See Appendix A). This is a statistic calculated from the annual summation of rainfall energy in every storm and its maximum 30-minute intensity.

7.6 Future Sediment TMDLs

As the science and available data for wet weather discharges of sediment continues to grow, more advanced approaches to sediment TMDLs are expected to be developed. These new approaches will be applied, as appropriate, through the adaptive management process to enhance the effectiveness of TMDLs and to provide a sound basis for water quality management decisions. A discussion of U.S. Environmental Protection Agency Region IV's proposed future approach to sediment TMDLs is provided in Appendix C.

8.0 IMPLEMENTATION PLAN

8.1 Point Sources

8.1.1 NPDES-Regulated Municipal and Industrial Wastewater Treatment Facilities

WLAs for WWTFs located in impaired HUC-12 subwatersheds will be implemented through each facility's NPDES permit. Since discharges from these facilities are small compared to the total sediment loading in impaired subwatersheds, WLAs are equal to existing permit requirements.

8.1.2 NPDES Regulated Ready Mixed Concrete Facilities

WLAs for RMCFs will be implemented through NPDES Permit No. TNG110000, *General NPDES Permit for Discharges of Storm Water Runoff and Process Wastewater Associated With Ready Mixed Concrete Facilities*. Since discharges from these facilities are small compared to the total sediment loading in impaired subwatersheds, WLAs are equal to existing permit requirements.

8.1.3 NPDES Regulated Mine Sites

WLAs for mining sites located in impaired HUC-12 subwatersheds will be implemented through each site's NPDES permit. Since discharges from these facilities are small compared to the total sediment loading in impaired subwatersheds, WLAs are equal to existing permit requirements.

8.1.4 Aquatic Resource Alteration Activities

WLAs for permitted stream alteration activities will be implemented through each activity's Aquatic Resource Alteration Permit (ARAP). Since loading from activities performed in accordance with the ARAP are considered small compared to the total sediment loading in impaired subwatersheds, WLAs are equal to existing permit requirements.

8.1.5 NPDES-Regulated Construction Storm Water

The WLAs provided to existing and future NPDES-regulated construction activities disturbing one acre or more will be implemented through Best Management Practices (BMPs) as specified in NPDES Permit No. TNR10-0000, *General NPDES Permit for Storm Water Discharges Associated With Construction Activit*y. It is not technically feasible to incorporate numeric sediment limits into permits for these activities at this time. WLAs should <u>not</u> be construed as numeric permit limits. This permit requires (ref.: Appendix E):

- Development and implementation of a site-specific Storm Water Pollution Prevention Plan (SWPPP) that addresses erosion and sediment control.
- Good engineering and best management practices in the design, installation, and maintenance of erosion and sediment controls.
- Erosion and sediment controls must be designed to function properly in a two-year, 24-hour storm event.

In addition, a number of special requirements in the permit apply to discharges entering waterbodies that have been identified on the 303(d) list as being impaired due to siltation. These additional requirements include:

- More frequent (weekly) inspections of erosion and sediment controls.
- Inspections and the condition of erosion and sediment controls must be reported to the Division of Water Pollution Control (DWPC).
- The SWPPP must be submitted to the DWPC prior to disturbing soil at the construction site.
- In order to assure that the WLA is achieved, the application of BMPs that go

beyond the typical minimum elements generally undertaken to comply with the General Permit may be necessary.

Strict compliance with the provisions of the *General NPDES Permit for Storm Water Discharges Associated With Construction Activit*y can reasonably be expected to achieve reduced sediment loads to streams. The primary challenge for the reduction of sediment loading from construction sites to meet TMDL WLAs is in the effective compliance monitoring of all requirements specified in the permit and timely enforcement against construction sites not found to be in compliance with the permit.

8.1.6 NPDES-Regulated Municipal Separate Storm Sewer Systems (MS4s)

For regulated discharges from municipal separate storm sewer systems, WLAs will be implemented through Phase II MS4 permits. These permits will require the development and implementation of a Storm Water Management Plan (SWMP) that will reduce the discharge of pollutants to the "maximum extent practicable" and not cause or contribute to violations of State water quality standards. The individual permittees will be responsible for identifying the specific BMPs to be applied to attain appropriate reduction in sediment loads. The SWMP will also include a number of programs/activities to identify sources of pollutants in municipal storm water runoff and verify SWMP effectiveness.

8.2 Nonpoint Sources

Reductions of sediment loading from nonpoint sources will be achieved using a phased and adaptive management approach. Voluntary, incentive-based mechanisms will be used to implement NPS management measures in order to assure that measurable reductions in sediment loadings can be achieved for the targeted impaired water. Cooperation and active participation by the general public and various industry, business, and environmental groups is critical to successful implementation of TMDLs. Local citizen-led and implemented management measures offer the most efficient and comprehensive avenue for reduction of loading rates from nonpoint sources. TMDL implementation activities will be accomplished within the framework of Tennessee's Watershed Approach (ref: http://www.state.tn.us/environment/wpc/watershed/).

The Watershed Approach is based on a five-year cycle and encompasses planning, monitoring , assessment, TMDLs, WLAs/LAs and permit issuance. It relies on participation at the federal, state, local and nongovernmental levels to be successful. The Lower Duck River Watershed Management Plan will be available in 2004 and will describe, in general, the partnerships among government agencies and stakeholder groups and the roles that each play in the effort to improve water quality in the Lower Duck River Watershed, including the reduction of pollutant loading.

Governmental agencies include:

- Natural Resources Conservation Service
- USGS Water Resource Programs—Tennessee District
- U.S. Environmental Protection Agency
- U.S. Fish and Wildlife Service
- Tennessee Valley Authority
- TDEC - Division of Water Supply
- TDEC - Division of Community Assistance
- Tennessee Department of Agriculture

- Tennessee Wildlife Resources Agency

Local stakeholder groups include:

- The Tennessee Duck River Development Agency – Larry Murdock, Coordinator, 210 East Depot Street, Shelbyville, TN 37160
- The Water Resources Council – Larry Murdock, Coordinator, c/o The Tennessee Duck River Development Agency, 210 East Depot Street, Shelbyville, TN 37160, 931-684-7820, duckrvr@bellsouth.net, www.duckriveragency.com
- The Duck River Project – c/o John McFadden, 688 Speck Road, Lebanon, TN 37087
- Swan Creek Trust – Cynthia Rohrbach, PO Box 162, Summertown, TN 38483

With respect to the reduction of nonpoint source sediment loading and habitat alteration, government agency and stakeholders should, at a minimum, be directed to:

- Implement and maintain conservation farming, including conservation tillage, contour strips and no till farming.
- Install grass buffer strips along streams.
- Reduce activities within riparian areas
- Minimize road and bridge construction impacts on streams

8.3 Evaluation of TMDL Effectiveness

The effectiveness of the TMDL will be assessed within the context of the State's rotating watershed management approach. Watershed monitoring and assessment activities will provide information by which the effectiveness of sediment loading reduction measures can be evaluated. Monitoring data, ground-truthing, and source identification actions will enable implementation of particular types of BMPs to be directed to specific areas in the subwatersheds. These TMDLs will be revaluated during subsequent watershed cycles and revised as required to assure attainment of applicable water quality standards.

9.0 PUBLIC PARTICIPATION

In accordance with 40 CFR §130.7, the proposed sediment TMDLs for the Lower Duck River Watershed will be placed on Public Notice for a 35-day period and comments solicited. Steps that will be taken in this regard include:

1) Notice of the proposed TMDLs will be posted on the Tennessee Department of Environment and Conservation website. The notice will invite public and stakeholder comments and provided a link to a downloadable version of the TMDL document.

2) Notice of the availability of the proposed TMDLs (similar to the website announcement) will be included in one of the NPDES permit Public Notice mailings.

3) A letter will be sent to point source facilities in the Lower Duck River Watershed that are permitted to discharge treated total suspended solids (TSS) advising them of the proposed sediment TMDLs and their availability on the TDEC website. The letter also

will state that a written copy of the draft TMDL document will be provided on request. Letters will be sent to the following facilities:

Solutia, Inc.	TN0001538
Spontex Inc.	TN0001571
UCAR Carbon Company Inc.	TN0002275
Columbia Water System WTP	TN0004375
Mount Pleasant STP	TN0020800
McEwen STP	TN0021741
Universal Fasteners, Inc. #1	TN0021962
Centerville STP	TN0024937
Glenn Springs Holdings, Inc.	TN0026441
Columbia STP	TN0056103
Hampshire Coin Laundry	TN0060291
Mount Pleasant WTP	TN0061689
East Hickman Co. Middle School	TN0067130
CYTEC Industries, Inc.	TN0067415
Spring Hill STP	TN0075868
Spring Hill WTP	TN0077933

4) A letter will be sent to the local stakeholder groups in the Lower Duck River Watershed advising them of the proposed sediment TMDLs and their availability on the TDEC website. The letter also will state that a written copy of the draft TMDL document will be provided upon request. Letters will be sent to the following local stakeholder groups:

The Tennessee Duck River Development Agency
The Water Resources Council
Swan Creek Trust
Duck River Project

5) A draft copy of the proposed sediment TMDLs will be sent to the City of Columbia and Tennessee Department of Transportation (TDOT). The City of Columbia was issued an MS4 permit under the Phase II storm water regulations (NPDES Permit TNS075248, issued July 3, 2003, effective July 7, 2003 and expires February 26, 2008). TDOT will be issued an MS4 permit as well (TNS077585, target public notice 7/5/2004). The federal guidance for Phase 1 Municipal Separate Storm Sewer Systems shall apply as well as the Amended Consent Order and Agreement between TDOT and the Division of Water Pollution Control dated March 10, 2004.

10.0 FURTHER INFORMATION

Further information concerning Tennessee's TMDL program can be found on the Internet at the Tennessee Department of Environment and Conservation website:

http://www.state.tn.us/environment/wpc/tmdl/

Technical questions regarding these TMDLs should be directed to the following members of the Division of Water Pollution Control staff:

Mary L. Wyatt, Watershed Management Section
e-mail: Mary.Wyatt@state.tn.us

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e-mail: Sherry.Wang@state.tn.us

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APPENDIX A

Watershed Sediment Loading Model

WATERSHED SEDIMENT LOADING MODEL

Determination of target average annual sediment loading values for reference watersheds and the sediment loading analysis of waterbodies impaired for siltation/habitat alteration was accomplished utilizing the Watershed Characterization System (WCS) Sediment Tool (v.2.6). WCS is an ArcView geographic information system (GIS) based program developed by USEPA Region IV to facilitate watershed characterization and TMDL development. WCS consists of an initial set of spatial and tabular watershed data, stored in a database, and allows the incorporation of additional data when available. It provides a number of reporting tools and data management utilities to allow users to analyze and summarize data. Program extensions, such as the sediment tool, expand the functionality of WCS to include modeling and other more rigorous forms of data analysis (USEPA, 2001).

Sediment Analysis

The Sediment Tool is an extension of WCS that utilizes available GIS coverages (land use, soils, elevations, roads, etc), the Universal Soil Loss Equation (USLE) to calculate potential erosion, and sediment delivery equations to calculate sediment delivery to the stream network. The following tasks can be performed:

- Estimate extent and distribution of potential soil erosion in the watershed.
- Estimate potential sediment delivery to receiving waterbodies.
- Evaluate effects of land use, BMPs, and road network on erosion and sediment delivery.

The Sediment Tool can also be used to evaluate different scenarios, such as the effects of changing land uses and implementation of BMPs, by the adjustment of certain input parameters. Parameters that may be adjusted include:

- Conservation management and erosion control practices
- Changes in land use
- Implementation of Best Management Practices (BMPs)
- Addition/Deletion of roads

Sediment analyses can be performed for single or multiple watersheds.

Universal Soil Loss Equation

Erosion potential is based on the Universal Soil Loss Equation (USLE), developed by Agriculture Research Station (ARS) scientists W. Wischmeier and D. Smith. It has been the most widely accepted and utilized soil loss equation for over 30 years. The USLE is a method to predict the average annual soil loss on a field slope based on rainfall pattern, soil type, topography, crop system, and management practices. The USLE only predicts the amount of soil loss resulting from sheet or rill erosion on a single slope and does not account for soil losses that might occur from gully, wind, or tillage erosion. Designed as a model for use with certain cropping and management systems, it is also applicable to non-agricultural situations (OMAFRA 2000). While the USLE can be used to estimate long-term average annual soil loss, it cannot be applied to a specific year or a specific storm. Based on its long history of use and wide acceptance by the forestry and agricultural communities, the USLE was considered to be an adequate tool for estimating the relative long-term average annual soil erosion of watersheds and evaluating the effects of land use changes and implementation of BMP measures.

Soil loss from sheet and rill erosion is primarily due to detachment of soil particles during rain events. It is the cause of the majority of soil loss for lands associated with crop production, grazing areas, construction sites, mine sites, logging areas, and unpaved roads. In the USLE, five major factors are used to calculate the soil loss for a given area. Each factor is the numerical estimate of a specific condition that affects the severity of soil erosion in that area. The USLE for estimating average annual soil erosion is expressed as:

$$A = R \times K \times LS \times C \times P$$

where:

A = average annual soil loss in tons per acre
R = rainfall erosivity index
K = soil erodibility factor
LS = topographic factor - L is for slope length and S is for slope
C = crop/vegetation & management factor
P = conservation practice factor

Evaluating the factors in USLE:

R - Rainfall Erosivity Index

The rainfall erosivity index describes the kinetic energy generated by the frequency and intensity of the rainfall. It is statistically calculated from the annual summation of rainfall energy in every storm, which correlates to the raindrop size, times its maximum 30-minute intensity. This index varies with geography.

K - Soil Erodibility Factor

This factor quantifies the cohesive or bonding character of the soil and its ability to resist detachment and transport during a rainfall event. The soil erodibility factor is a function of soil type.

LS - Topographic Factor

The topographic factor represents the effect of slope length and slope steepness on erosion. Steeper slopes produce higher overland flow velocities. Longer slopes accumulate runoff from larger areas and also result in higher flow velocities. For convenience L and S are frequently lumped into a single term.

C – Crop/Vegetation & Management Factor

The crop/vegetation and management factor represents the effect that ground cover conditions, soil conditions, and general management practices have on soil erosion. It is the most computationally complicated of USLE factors and incorporates the effects of: tillage management, crop type, cropping history (rotation), and crop yield.

P - Conservation Practice Factor

The conservation practice factor represents the effects on erosion of Best Management Practices (BMPs) such as contour farming, strip cropping and terracing.

Estimates of the USLE parameters, and thus the soil erosion as computed from the USLE, are provided by the Natural Resources Conservation Service's (NRCS) National Resources Inventory (NRI) 1994. The NRI database contains information of the status, condition, and trend of soil, water and related resources collected from approximately 800,000 sampling points across the country.

The soil losses from the erosion processes described above are localized losses and not the total amount of sediment that reaches the stream. The fraction of the soil lost in the field that is eventually delivered to the stream depends on several factors. These include, the distance of the source area from the stream, the size of the drainage area, and the intensity and frequency of rainfall. Soil losses along the riparian areas will be delivered into the stream with runoff-producing rainfall.

Sediment Modeling Methodology

Using WCS and the Sediment Tool, average annual sediment loading to surface waters was modeled according to the following procedures:

1. A WCS project was setup for the watershed that is the subject of these TMDLs. Additional data layers required for sediment analysis were generated or imported into the project. These included:

    DEM (grid) – The Digital Elevation Model (DEM) layers that come with the basic WCS distribution system are shapefiles of coarse resolution (300x300m). A higher resolution DEM grid layer (30x30m) is required. The National Elevation Dataset (NED) is available from the USGS website and the coverage for the watershed (8-digit HUC) was imported into the project.

    Road – A road layer is needed as a shape file and requires additional attributes such as road type, road practice, and presence of side ditches. If these attributes are not provided, the Sediment Tool automatically assigns default values: road type - secondary paved roads, side ditches present, and no road practices. This data layer was obtained from ESRI for areas in the watershed.

    Soil – The SSURGO (1:24k) soil data may be imported into the WCS project if higher-resolution soil data is required for the estimation of potential erosion. If the SSURGO soil database is not available, the system uses the STATSGO Soil data (1:250k) by default.

    MRLC Land Use – The Multi-Resolution Land Characteristic (MRLC) data set for the watershed is provided with the WCS package, but must be imported into the project.

2. Using WCS, the entire watershed was delineated into 35 subwatersheds corresponding to USGS 12-digit Hydrologic Unit Codes (HUCs). These delineations are shown in Figure 6. Land use distribution for these delineations is summarized in Appendix B. All of the sediment analyses were performed on the basis of these drainage areas.

The following steps are accomplished using the WCS Sediment Tool:

3. For a selected watershed or subwatershed, a sediment project is set up in a new view that contains the data layers that will be subsequently used to calculate erosion and sediment delivery.

4. A stream grid for each delineated subwatershed was created by etching a stream coverage, based on Reach File v. 3 (Rf3) or National Hydrology Dataset (NHD), to the DEM grid.

5. For each 30 by 30 meter grid cell within the subwatershed, the Sediment Tool calculates the potential erosion using the USLE based on the specific cell characteristics. The model then calculates the potential sediment delivery to the stream grid network. Sediment delivery can be calculated using one of the four available sediment delivery equations:

   - Distance-based equation (Sun and McNulty 1998)
     Mad = M * (1-0.97 * D/L)
     where: Mad = mass moved (tons/acre/yr)
     M = sediment mass eroded (ton)
     D = least cost distance from a cell to the nearest stream grid (ft)
     L = maximum distance the sediment may travel (ft)

   - Distance Slope-based equation (Yagow et al. 1998)
     DR = exp(-0.4233 * L * So)
     So = exp (-16.1 * r/L+ 0.057)) - 0.6
     where: DR = sediment delivery ration
     L = distance to the stream (m)
     r = relief to the stream (m)

   - Area-based equation (USDASCS 1983)
     $DR = 0.417762 * A^{(-0.134958)} - 1.27097, \quad DR <= 1.0$
     where: DR = sediment delivery ratio
     A = area (sq miles)

   - WEEP-based regression equation (Swift 2000)
     $Z = 0.9004 - 0.1341 * X^2 + X^3 - 0.0399 * Y + 0.0144 * Y^2 + 0.00308 * Y^3$
     where: Z = percent of source sediment passing to the next grid cell
     X = cumulative distance down slope (X > 0)
     Y = percent slope in the grid cell (Y > 0)

   The distance slope based equation (Yagow et al. 1998) was selected to simulate sediment delivery in the Lower Duck River Watershed.

6. The total sediment delivered upstream of each subwatershed "pour point" is calculated. The sediment analysis provides the calculations for six new parameters:

   - Source Erosion – estimated erosion from each grid cell due to the land cover
   - Road Erosion – estimated erosion from each grid cell representing a road
   - Composite Erosion – composite of the source and road erosion layers
   - Source Sediment – estimated fraction of the soil erosion from each grid cell that reaches the stream (sediment delivery)
   - Road Sediment – estimated fraction of the road erosion from each grid cell that reaches the stream

- Composite Sediment – composite of the source and erosion sediment layers

The sediment delivery can be calculated based on the composite sediment, road sediment, or source sediment layer. The sources of sediment by each land use type is determined showing the types of land use, the acres of each type of land use, and the tons of sediment estimated to be generated from each land use.

7. For each subwatershed of interest, the resultant sediment load calculation is expressed as a long-term average annual soil loss expressed in pounds per year calculated for the rainfall erosivity index (R). This statistic is calculated from the annual summation of rainfall energy in every storm (correlates with raindrop size) times its maximum 30-minute intensity.

Calculated erosion, sediment loads delivered to surface waters, and unit loads (per unit area) for subwatersheds that contain waters on the 2002 303(d) list as impaired for siltation and/or habitat alteration are summarized in Tables A-1, A-2, and A-3, respectively.

Table A-1 Calculated Erosion - Subwatersheds With Waterbodies on the 2002 303(d) List

HUC-12 Subwatershed (06040003__)	*EROSION*				
	Source [tons/yr]	Road [tons/yr]	Total [tons/yr]	%Source	%Road
0101	23009	10827	33836	68.0	32.0
0102	25248	10734	35982	70.2	29.8
0201	28738	5233	33971	84.6	15.4
0202	16681	4016	20697	80.6	19.4
0303	19056	5784	24840	76.7	23.3
0701	30511	7903	38413	79.4	20.6

Table A-2 Calculated Sediment Delivery to Surface Waters - Subwatersheds with Waterbodies on the 2002 303(d) List

HUC-12 Subwatershed (06040003__)	*SEDIMENT*				
	Source [tons/yr]	Road [tons/yr]	Total [tons/yr]	%Source	%Road
0101	6909	5362	12271	56.3	43.7
0102	8151	5042	13192	61.8	38.2
0201	11335	3004	14339	79.1	20.9
0202	7302	1940	9242	79.0	21.0
0303	5707	3219	8926	63.9	36.1
0701	12313	4165	16479	74.7	25.3

Table A-3 Unit Loads - Subwatersheds With Waterbodies on the 2002 303(d) List

HUC-12 Subwatershed (06040003__)	*UNIT LOADS*		
	Erosion	Sediment	
	[tons/ac/yr]	[tons/ac/yr]	[lbs/ac/yr]
0101	1.553	0.563	1127
0102	1.211	0.444	888
0201	1.049	0.443	885
0202	1.052	0.470	940
0303	0.945	0.340	679
0701	1.358	0.583	1165

APPENDIX B

Subwatershed Land Use

Table B-1 Lower Duck River Watershed – Subwatershed Land Use Distribution

Land Use	Subwatershed (06040003___)											
	0101		0102		0103		0104		0105		0106	
	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]
Bare Rock/Sand/Clay	0	0										
Deciduous Forest	3699	17	8081	27.2	7334	20.8	4094	37.9	7864	45.6	16850	70.3
Emergent Herbaceous Wetlands			5	0	17	0	284	2.6			1	0
Evergreen Forest	974	4.5	1210	4.1	1305	3.7			260	1.5	259	1.1
High Intensity Commercial/Industrial/Transportation	850	3.9	634	2.1	236	0.7	5	0	18	0.1	26	0.1
High Intensity Residential	313	1.4	154	0.5	12	0						
Low Intensity Residential	1331	6.1	1166	3.9	188	0.5	15	0.1	33	0.2	24	0.1
Mixed Forest	3671	16.9	4474	15.1	5506	15.6	2348	21.8	2149	12.5	1493	6.2
Open Water	238	1.1	15	0	969	2.8	2	0	6	0	105	0.4
Other Grasses (Urban/Recreational)	199	0.9	280	0.9	53	0.2	5	0	22	0.1	12	0
Pasture/Hay	7838	36	11230	37.8	14164	40.2	3554	32.9	5871	34.1	4224	17.6
Quarries/Strip Mines/Gravel Pits	127	0.6			33	0.1						
Row Crops	2203	10.1	2175	7.3	4620	13.1	480	4.4	906	5.3	914	3.8
Transitional	272	1.2	5	0	208	0.6	3	0	13	0.1	6	0
Woody Wetlands	59	0.3	274	0.9	548	1.6			98	0.6	57	0.2
Total	**21775**	**100**	**29704**	**100**	**35194**	**100**	**10790**	**99.9**	**17241**	**100**	**23971**	**100**

Table B-1 (cont.) Lower Duck River Watershed – Subwatershed Land Use Distribution

Land Use	Subwatershed (06040003___)											
	0107		0108		0201		0202		0203		0301	
	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]
Bare Rock/Sand/Clay							1	0				
Deciduous Forest	21376	51.3	18278	60.1	8151	25.2	3389	17.2	4756	21.7	21370	71.1
Emergent Herbaceous Wetlands	12	0	5	0	20	0.1	5	0	9	0		
Evergreen Forest	565	1.4	517	1.7	651	2	785	4	298	1.4	632	2.1
High Intensity Commercial/Industrial/Transportation	26	0.1	38	0.1	251	0.8	136	0.7	76	0.3	100	0.3
High Intensity Residential	1	0	8	0	18	0.1	10	0	2	0	1	0
Low Intensity Residential	15	0	122	0.4	255	0.8	262	1.3	34	0.2	57	0.2
Mixed Forest	3271	7.8	2334	7.7	3438	10.6	2952	15	2158	9.8	1704	5.7
Open Water	659	1.6	2	0	36	0.1	122	0.6	32	0.1	15	0.1
Other Grasses (Urban/Recreational)	36	0.1	2	0	348	1.1	99	0.5			22	0.1
Pasture/Hay	12101	29	7645	25.2	13629	42.1	9239	47	11516	52.6	4376	14.6
Quarries/Strip Mines/Gravel Pits			16	0.1	6	0	50	0.3	199	0.9	151	0.5
Row Crops	3010	7.2	1251	4.1	5259	16.2	2016	10.3	2592	11.8	1586	5.3
Transitional	19	0	24	0.1	124	0.4	81	0.4	0	0	56	0.2
Woody Wetlands	614	1.5	153	0.5	194	0.6	512	2.6	242	1.1		
Total	**41702**	**100**	**30395**	**100**	**32382**	**100**	**19660**	**100**	**21915**	**100**	**30070**	**100**

Table B-1 (cont.) Lower Duck River Watershed – Subwatershed Land Use Distribution

Land Use	Subwatershed (06040003___)											
	0302		0303		0401		0402		0501		0502	
	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]
Bare Rock/Sand/Clay			1	0								
Deciduous Forest	5018	19.2	8676	33	15916	73.3	30259	70.8	12725	68.3	21272	67.2
Emergent Herbaceous Wetlands	11	0	4	0					1	0	11	0
Evergreen Forest	609	2.3	1353	5.1	219	1	543	1.3	190	1	488	1.5
High Intensity Commercial/Industrial/Transportation	53	0.2	174	0.7	26	0.1	154	0.4	58	0.3	184	0.6
High Intensity Residential	4	0	52	0.2			2	0	3	0	42	0.1
Low Intensity Residential	63	0.2	466	1.8	7	0	62	0.1	54	0.3	294	0.9
Mixed Forest	2648	10.1	5093	19.4	585	2.7	1681	3.9	634	3.4	1432	4.5
Open Water	28	0.1	573	2.2	1	0	6	0	145	0.8	469	1.5
Other Grasses (Urban/Recreational)	21	0.1	362	1.4			67	0.2	52	0.3	126	0.4
Pasture/Hay	13614	52	7107	27	3648	16.8	6859	16.1	3208	17.2	4972	15.7
Quarries/Strip Mines/Gravel Pits			12	0			43	0.1	10	0.1		
Row Crops	3104	11.9	2137	8.1	1297	6	2977	7	1152	6.2	1613	5.1
Transitional	0	0	46	0.2	24	0.1	71	0.2	89	0.5	247	0.8
Woody Wetlands	987	3.8	221	0.8					301	1.6	502	1.6
Total	**26160**	**100**	**26277**	**100**	**21723**	**100**	**42724**	**100**	**18621**	**100**	**31653**	**100**

Table B-1 (cont.) Lower Duck River Watershed – Subwatershed Land Use Distribution

Land Use	Subwatershed (06040003___)											
	0503		0504		0505		0506		0507		0601	
	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]
Bare Rock/Sand/Clay					7	0						
Deciduous Forest	39199	83.6	18832	94.8	23323	66	27119	82.3	20652	77.7	37009	84.9
Emergent Herbaceous Wetlands					118	0.3					2	0
Evergreen Forest	413	0.9	47	0.2	254	0.7	99	0.3	238	0.9	551	1.3
High Intensity Commercial/Industrial/Transportation	164	0.3	140	0.7	104	0.3	24	0.1	53	0.2	130	0.3
High Intensity Residential									24	0.1	33	0.1
Low Intensity Residential	1	0	0	0	4	0	2	0	157	0.6	95	0.2
Mixed Forest	1073	2.3	170	0.9	838	2.4	463	1.4	620	2.3	934	2.1
Open Water	719	1.5	2	0	2252	6.4	1	0	6	0	3	0
Other Grasses (Urban/Recreational)	71	0.2	50	0.3	6	0	22	0.1	51	0.2	61	0.1
Pasture/Hay	2824	6	194	1	3986	11.3	2248	6.8	2410	9.1	2251	5.2
Quarries/Strip Mines/Gravel Pits											5	0
Row Crops	2250	4.8	325	1.6	3169	9	2863	8.7	2298	8.6	1627	3.7
Transitional	160	0.3	97	0.5	128	0.4	103	0.3	59	0.2	698	1.6
Woody Wetlands	27	0.1			1173	3.3			7	0	209	0.5
Total	**46901**	**100**	**19858**	**100**	**35363**	**100**	**32944**	**100**	**26576**	**100**	**43608**	**100**

Table B-1 (cont.) Lower Duck River Watershed – Subwatershed Land Use Distribution

Land Use	Subwatershed (06040003___)											
	0602		0603		0701		0702		0703		0704	
	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]
Bare Rock/Sand/Clay												
Deciduous Forest	22795	85.4	24330	84.8	16841	59.6	23687	63.4	12605	70.7	28000	74
Emergent Herbaceous Wetlands			1	0							0	0
Evergreen Forest	231	0.9	296	1	261	0.9	417	1.1	88	0.5	421	1.1
High Intensity Commercial/Industrial/Transportation	53	0.2	95	0.3	546	1.9	242	0.6	93	0.5	173	0.5
High Intensity Residential	3	0			106	0.4	9	0			3	0
Low Intensity Residential	34	0.1	4	0	553	2	152	0.4	41	0.2	44	0.1
Mixed Forest	965	3.6	776	2.7	1606	5.7	1762	4.7	389	2.2	967	2.6
Open Water	55	0.2	31	0.1	35	0.1	37	0.1	13	0.1	135	0.4
Other Grasses (Urban/Recreational)	26	0.1			188	0.7	223	0.6	39	0.2	92	0.2
Pasture/Hay	1203	4.5	1694	5.9	5388	19.1	6848	18.3	2379	13.3	4564	12.1
Quarries/Strip Mines/Gravel Pits	50	0.2	44	0.2	56	0.2			10	0.1		
Row Crops	871	3.3	995	3.5	2695	9.5	3946	10.6	1910	10.7	2896	7.6
Transitional	418	1.6	71	0.2	5	0	65	0.2	261	1.5	417	1.1
Woody Wetlands			358	1.2							145	0.4
Total	**26705**	**100**	**28695**	**100**	**28281**	**100**	**37386**	**100**	**17828**	**100**	**37857**	**100**

Table B-1 (cont.) Lower Duck River Watershed – Subwatershed Land Use Distribution

Land Use	Subwatershed (06040003___)									
	0705		0801		0802		0901		0902	
	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]
Bare Rock/Sand/Clay										
Deciduous Forest	17518	80.8	30964	78.1	11783	92.7	20367	77.8	20347	78.9
Emergent Herbaceous Wetlands			0	0			0	0		
Evergreen Forest	274	1.3	545	1.4	83	0.7	84	0.3	181	0.7
High Intensity Commercial/Industrial/Transportation	112	0.5	49	0.1	11	0.1	48	0.2	10	0
High Intensity Residential	8	0					1	0		
Low Intensity Residential	105	0.5	48	0.1	1	0	43	0.2	17	0.1
Mixed Forest	705	3.3	1257	3.2	176	1.4	390	1.5	560	2.2
Open Water	4	0	1	0	0	0	66	0.3	1	0
Other Grasses (Urban/recreational)	130	0.6	6	0	2	0	18	0.1	53	0.2
Pasture/Hay	1546	7.1	2954	7.5	222	1.7	2532	9.7	2309	9
Quarries/Strip Mines/Gravel Pits										
Row Crops	1168	5.4	2715	6.9	257	2	2370	9.1	2211	8.6
Transitional	119	0.5	966	2.4	179	1.4	213	0.8	83	0.3
Woody Wetlands			122	0.3			48	0.2		
Total	**21689**	**100**	**39628**	**100**	**12715**	**100**	**26181**	**100**	**25773**	**100**

Table B-2 Level IV Ecoregion Reference Site Drainage Area Land Use Distribution

Land Use	Ecosite Subwatershed									
	Eco71f12		Eco71f16		Eco71f19		Eco71f27		Eco71f28	
	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]
Bare Rock/Sand										
Deciduous Forest	4839	71.7	9655	97.7	6610	80.9	1888	59.0	4920	88.5
Emergent Herbaceous Wetlands										
Evergreen Forest	39	0.6	21	0.2	163	2.0	909	28.4	157	2.8
High Intensity Commercial / Industrial / Transportation	1	0.0	7	0.1	2	0.0	10	0.3	6	0.1
High Intensity Residential										
Low Intensity Residential	5	0.1			2	0.0	0	0.0	1	0.0
Mixed Forest	155	2.3	68	0.7	159	1.9	233	7.3	108	1.9
Open Water	2	0.0			1	0.0			1	0.0
Other Grasses (Urban / Recreational)					1	0.0			4	0.1
Pasture / Hay	1242	18.4	94	1.0	341	4.2	6	0.2	199	3.6
Quarries / Strip Mines / Gravel Pits										
Row Crops	461	6.8	0	0.0	668	8.2	48	1.5	139	2.5
Transitional	1	0.0	33	0.3	177	2.2	108	3.4	23	0.4
Woody Wetlands					36	0.4				
Total	**6746**	**100.0**	**9879**	**100.0**	**8161**	**99.9**	**3201**	**100.0**	**5558**	**100.0**

Table B-2 (Cont.) Level IV Ecoregion Reference Site Drainage Area Land Use Distribution

Land Use	Ecosite Subwatershed									
	Eco71h03		Eco71h06		Eco71h09		Eco71i03		Eco71i10	
	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]
Bare Rock/Sand	0.0	0.0	0.0	0.0	0.0	0.0				
Deciduous Forest	6784.0	81.6	7788.0	88.7	6264.0	79.0	8152	53.3	4755	39.4
Emergent Herbaceous Wetlands	0.0	0.0	0.0	0.0	0.0	0.0				
Evergreen Forest	137.0	1.6	137.0	1.6	245.0	3.1	1013	6.6	669	5.5
High Intensity Commercial / Industrial / Transportation	20.0	0.2	2.0	0.0	6.0	0.1	29	0.2	4	0.0
High Intensity Residential	14.0	0.2	0.0	0.0	0.0	0.0	11	0.1		
Low Intensity Residential	136.0	1.6	2.0	0.0	36.0	0.5	141	0.9	9	0.1
Mixed Forest	757.0	9.1	604.0	6.9	722.0	9.1	2853	18.7	2377	19.7
Open Water	0.0	0.0	1.0	0.0	0.0	0.0	33	0.2	1	0.0
Other Grasses (Urban / Recreational)	52.0	0.6	0.0	0.0	0.0	0.0	41	0.3	8	0.1
Pasture / Hay	395.0	4.7	193.0	2.2	494.0	6.2	2093	13.7	3302	27.3
Quarries / Strip Mines / Gravel Pits	0.0	0.0	0.0	0.0	0.0	0.0				
Row Crops	23.0	0.3	50.0	0.6	167.0	2.1	917	6	953	7.9
Transitional	0.0	0.0	1.0	0.0	0.0	0.0	6	0		
Woody Wetlands	0.0	0.0	0.0	0.0	0.0	0.0				
Total	**8318.0**	**100.0**	**8778.0**	**100.0**	**7934.0**	**100.0**	**15291**	**100**	**12079**	**100.0**

Table B-2 (Cont.) Level IV Ecoregion Reference Site Drainage Area Land Use Distribution

Land Use	Ecosite Subwatershed							
	Eco71i12		Eco71i13		Eco71i14		Eco71i15	
	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]
Bare Rock/Sand								
Deciduous Forest	4495	25.2	14482	38.1	1687	39.4	11842	27.4
Emergent Herbaceous Wetlands							12	0
Evergreen Forest	640	3.6	3744	9.8	95	2.2	2334	5.4
High Intensity Commercial / Industrial / Transportation	96	0.5	81	0.2	1	0	125	0.3
High Intensity Residential	0	0	3	0			5	0
Low Intensity Residential	55	0.3	128	0.3	5	0.1	262	0.6
Mixed Forest	2106	11.8	8012	21.1	526	12.3	6707	15.5
Open Water	7	0	5	0	0	0	61	0.1
Other Grasses (Urban / Recreational)	35	0.2	14	0			139	0.3
Pasture / Hay	6846	38.4	7896	20.7	1311	30.7	14171	32.8
Quarries / Strip Mines / Gravel Pits								
Row Crops	3571	20	3506	9.2	574	13.4	7163	16.6
Transitional			56	0.1	73	1.7	109	0.3
Woody Wetlands			130	0.3			310	0.7
Total	**17852**	**100**	**38054**	**100**	**4273**	**99.9**	**43239**	**100**

APPENDIX C

Future Sediment TMDL Related Work in EPA Region IV

1.0 Existing Approach

TMDLs are established at levels necessary to attain and maintain the applicable narrative and numerical water quality standards. (See 40 CFR Section 130.7(c)(1).) Most State Water Quality Standards do not include a numerical water quality standard for aquatic life protection due to sediment. The narrative standard is to maintain the biological integrity of the waters of the State.

The TMDL sediment linkage is defined as the cause and effect relationship between the biological integrity, habitat alteration and identified sediment sources.

An analysis of watershed sediment loading can be conducted at various levels of complexity, ranging from a simplistic gross estimate to a dynamic model that captures the detailed runoff from the watershed to the receiving waterbody. The limited amount of data available for the most regional watersheds prevented EPA from presently using a detailed dynamic watershed runoff model. Instead, EPA determined the sediment contributions to the impaired segments based on an average annual load of sediment from the upstream watershed. Comparing this impaired segment's watershed sediment load to an average annual sediment load from a biologically and habitat unimpaired watershed provides the basis for estimating any needed load reductions for the impaired segments.

Watershed-scale loading of sediment in water and sediment are estimated using the Watershed Characterization System (WCS) Sediment Tool. The ArcView based WCS Sediment Tool loading function model, based on the Universal Soil Loss Equation, falls between that of a detailed simulation model, which attempts a mechanistic, time-dependent representation of pollutant load generation and transport, and simple export coefficient models, which do not represent temporal or spatial variability. The WCS Sediment Tool provides a mechanistic, simplified simulation of precipitation-driven runoff and sediment delivery, yet is intended to be applicable without calibration. Sediment load from runoff can be used to estimate pollutant delivery to the receiving waterbody from the watershed. This estimate is based on sediment concentrations in storm water and an estimate of the average annual sediment load ultimately delivered to the receiving waterbody by runoff and erosion.

2.0 Future Work

Region IV is working with the Region IV States, Federal and State agencies and a Technical Advisory Group, to develop better and more technically sound TMDLs procedures for sediment. This ongoing work includes:

2.1 Development of ecoregion sediment loading curves for unimpaired streams

Development of allowable instream ecoregion based sediment concentrations (for various flow conditions;

Given that a major source of sediment in the impaired unstable streams are from eroding channel banks, in-stream loadings will be simulated using the channel-evolution model; and

Develop a more effective and transferable monitoring strategy for evaluating sediment impacts in streams.

2.2 Development of Ecoregion Sediment Loading Curves

Development of ecoregion sediment loading curves in EPA Region IV will require the establishment of the link between geomorphic, sediment and biologic characteristics of streams in the Southeast USA. Ongoing work, with the USDA - Agricultural Research Service, National Sedimentation Laboratory entails the review of 282 stream sites in seven Level III ecoregions in EPA Region IV. The tasks involve evaluating those streams that have existing records of flow and sediment transport as measured by other Federal agencies (U.S. Geological Survey and U.S. Department of Agriculture). Field and analytic work will be performed on this existing data to determine “reference” sediment-transport conditions and the likelihood that streams are impacted and/or impaired due to excess sediment.

The output of this work will be the results of the analysis of “reference” sediment-transport conditions and describe a rapid approach that TMDL practitioners can use to determine impairment in streams due to excess sediment.

USDA - Agricultural Research Service, National Sedimentation Laboratory will:

- Conduct rapid geomorphic assessments (RGAs) and determine stage of channel evolution at the 282 sites in seven Level III ecoregions in EPA Region IV. From the total number of 282 sites, select a minimum of two “reference” and two impacted sites in each ecoregion to perform detailed analysis of flow, sediment transport and aquatic community structure. Sites will be used to evaluate links between stage of channel evolution, sediment indices, and biologic integrity. All sites will be located within the states of EPA Region IV.

- Acquire from USDA and USGS existing historical flow and sediment-transport data for all sites selected in Task A. Evaluate sediment yields at the effective discharge and determine from detailed gage records, the channel stability conditions at the time of historical sediment sampling. Characterize the sediment-transport rate at the effective discharge at all sites.

- Acquire 15-minute discharge data and combine with sediment-transport data to determine the frequency, and duration of sediment transport at the four selected sites in each ecoregion. Develop frequency and duration relations for “reference” and impacted sites and compare with available biologic data to assess potential threshold levels of concentration.

- Acquire all existing historical data that may be available on the stream/reach and collect information on bank-material shear strength, bed-material size and erodibility, channel cross-sections and profiles.

- Assemble all sediment-transport results into data tables and histograms for each ecoregion and compare these values with stage VI “reference conditions.”

2.3 Development of allowable instream ecoregion based sediment concentrations

EPA Region IV is participating on Sediment TMDL Technical Advisory Group sponsored by the Georgia Nature Conservancy and the University of Georgia in Athens. A preliminary recommendation from the group is that a TMDL should be expressed as an annual sediment load and a daily sediment load and concentration. The daily load will depend on flow. If an average flow is used for daily load, then this would represent an upper limit for base-flow or chronic conditions. If sediment rating curve slope is available, a flow and sediment concentration for storm flow conditions can be used to calculate a daily-load upper limit that would represent acute condition. Work is ongoing to refine the proposal and to test the proposal in various ecoregions in Georgia.

2.4 Instream loadings simulated using the channel-evolution model

Given that a major source of sediment in the region's stream is from eroding channel banks, in-stream sediment loads will be simulated using other more complex, process-based models like GSTARS or CONCEPTS. These models require a more robust sediment and flow database in the individual watershed. One useful exercise will be to compare the model outputs from some of the preliminary Phase I TMDLs produced by Region IV via BASINS within the South Fork Broad Watershed (noted above) to other more complex, process-based models.

The EPA ORD work on the Broad River sediment data collection project will be useful to compare with other efforts within the Region to develop sediment TMDLs in the Piedmont, Coastal Plain and Interior Plateau. It will also be useful to compare the results of the ORD project to some of the work currently underway between EPA Region IV and the USDA-ARS, National Sedimentation Laboratory in Oxford, Mississippi.

2.5 Develop a more effective and transferable monitoring strategy for evaluating sediment impacts in streams

Monitoring is a key component of the TMDL process and should be particularly emphasized in the Phased TMDLs because of the uncertainty surrounding their establishment. At a minimum, the monitoring program will have to address the issues of discharge, sediment concentrations and loads, and very importantly, temporal resolution (daily, weekly, monthly, seasonally, yearly). The monitoring plan must incorporate the use of consistent and accurate sampling and analytical procedures.

In EPA Region IV's Science and Ecosystem Support Division (SESD) and Water Management Division (WMD) and EPA's Office of Research and Development (ORD) are working on the refinement and implementation of both habitat and biological assessments and sediment storm water monitoring strategies to gather the data and information necessary to develop the more complex TMDLs. These strategies include the measurement of sediment reaching the stream and instream sediment sources.

APPENDIX D

Estimate of Existing Point Source Loads for NPDES Permitted Wastewater Treatment Facilities, Mining Sites & Ready Mixed Concrete Facilities

Determination of Existing Point Source Sediment Loads

Existing point source sediment loads for several classes of permitted facilities located in impaired HUC-12 subwatersheds were estimated using the methodologies described below.

<u>Wastewater Treatment Facilities (WWTFs)</u>

Existing loads for WWTFs are based on facility design flow, the monthly average permit limit for TSS, and the area of the HUC-12 subwatershed in which the facility is located. Loads are expressed as average annual loads per unit area and are summarized in Table D-1.

$$AAL_{WWTF} = \frac{(Q_d) \text{ x } (MAvg)\ (8.34 \text{ lb-l/gal-mg})\ (365 \text{ days/yr})}{(A_{HUC\text{-}12})}$$

where: AAL = Average annual load [lb/ac/yr]
Q_d = Facility design flow [MGD]
MAvg = Monthly average concentration limit for TSS [mg/l]
$A_{HUC\text{-}12}$ = Area of impaired HUC-12 subwatershed [acres]

Table D-1 Estimate of Existing Load – Wastewater Treatment Facilities

HUC-12 SubWS (06040003___)	SubWS Area	NPDES Permit No.	Design Flow	Monthly Average TSS Limit	Annual Average Load
	[acres]		[MGD]	[mg/l]	[lb/ac/yr]
0101	21782.3	TN0001571	0.2602	30	1.091
0101	21782.3	TN0002275 Outfall 001	0.6645	40	3.715
0101	21782.3	TN0002275 Outfall 002	0	50	0
0101	21782.3	TN0002275 Outfall 003	0.0146	30	0.061
0101	21782.3	TN0004375	[a]	40[b]	0
0101	21782.3	TN0026441 Outfall 001	0.547	15	1.147
0101	21782.3	TN0026441 Outfall 002	0.006 [c]	55	0.046
0201	32395.8	TN0075868	2	30	5.638
0202	19670.8	TN0077933	0.296	40[b]	1.832
0303	26289.4	TN0020800	0.71	40	3.288

[a] Zero discharge, land applied through a spray field application on CWS property
[b] Daily Maximum Limit [mg/L]
[c] Storm water runoff from ore settling pond, 0.006 MGD Long-term average (2.2 MGY)

Mining Sites

Existing loads for permitted mining sites are based on an assumed runoff from the site drainage area, the daily maximum permit limit for TSS, and the area of the HUC-12 subwatershed in which the mining site is located (see Table D-2). Site runoff was estimated by assuming that one half of the annual precipitation falling on the site area results in runoff. Annual precipitation for the Lower Duck watershed is approximately 52 in/yr.

$$AAL_{Mining} = \frac{(A_d)\ (DMax)\ (Precip)\ (0.2266\ \text{lb-l/ac-in-mg})\ (0.5)}{(A_{HUC\text{-}12})}$$

where: AAL = Average annual load [lb/yr]
A_d = Facility (site) drainage area [acres]
DMax = Daily maximum concentration limit for TSS [mg/l]
Precip = Average annual precipitation for watershed [in/yr]
$A_{HUC\text{-}12}$ = Area of impaired HUC-12 subwatershed [acres]

Table D-2 Estimate of Existing Load – NPDES Permitted Mining Sites

HUC-12 Subwatershed (06040003___)	Subwatershed Area	Precip.[a]	NPDES Permit No.	Site Drainage Area	Daily Maximum TSS Limit	Annual Average Load
	[acres]	[in/yr]		[acres]	[mg/l]	[lb/ac/yr]
0202	19670.8	52	TN0004171	40	40	0.479

[a] Livestock Waste Facilities Handbook, 2nd Edition, 1985, Figure 11-12b

Ready Mixed Concrete Facilities (RMCFs)

Total loading from RMCFs is the sum of loading from process wastewater discharges and storm water runoff. Estimates of loading (see Table D-3) from these two sources were determined using methods similar to those used to determine WWTF and mining site loads.

Table D-3 Estimate of Existing Loads – Ready Mixed Concrete Facilities

HUC -12 Sub WS	Sub WS Area [acres]	NPDES Permit No.	Process Wastewater			Storm Water Runoff			Total Annual Ave Load
			Est. Flow	Daily Max TSS Limit	Annual Ave Load	Site Drain Area	TSS Cut-off Conc	Annual Ave Load	
			[MGD]	[mg/l]	[lb/ac/yr]	[acres]	[mg/l]	[lb/ac/yr]	[lb/ac/yr]
0101	21,782	TNG110120	0.0001	50	0.0007	6.0	200	0.3246	0.325
0101	21,782	TNG110241	0.0001	50	0.0007	3.5	200	0.1893	0.190
0202	19,671	TNG110055	0.0001	50	0.0008	5.14	200	0.3079	0.309
0701	28,285	TNG110205	0.0001	50	0.0005	2.61	200	0.1087	0.109
0701	28,285	TNG110235	0.0001	50	0.0005	7.42	200	0.3091	0.310

Total Existing Point Source Loads for Impaired HUC-12 Subwatersheds

Estimated point source loads were summed for each impaired HUC-12 subwatershed and then compared to both existing and target subwatershed sediment loads (see Table D-4).

Table D-4 Estimate of Existing Point Source Loads in Impaired HUC-12 Subwatersheds

HUC-12 SubWS	Level IV Eco Rgn	NPDES Permit No.	Facility Type	Ave Annual Point Source Load [lb/ac/yr]	Existing SubWS Load [a] [lb/ac/yr]	Point Source Percentage of Existing Load [%]	SubWS Target Load [b] [lb/ac/yr]	Point Source Percentage of Target Load [%]
0101	71h	TN0001571	WWTF	1.091				
		TN0002275 Outfall 001	WWTF	3.715				
		TN0002275 Outfall 002	WWTF	0				
		TN0002275 Outfall 003	WWTF	0.061				
		TN0004375	WWTF	0				
		TN0026441 Outfall 001	WWTF	1.147				
		TN0026441 Outfall 002	WWTF	0.046				
		TNG110120	RMCF	0.325				
		TNG110241	RMCF	0.190				
	Subwatershed 0101 Total			**6.575**	**1127**	**0.58**	**597.6**	**1.10**
0201	71i	TN0075868	WWTF	5.638				
	Subwatershed 0201 Total			**5.638**	**885**	**0.64**	**347.3**	**1.62**
0202	71h	TN0004171	Mining	0.479				
		TN0077933	WWTF	1.832				
		TNG110055	RMCF	0.309				
	Subwatershed 0202 Total			**2.62**	**940**	**0.28**	**597.6**	**0.44**
0303	71h	TN0020800	WWTF	3.288				
	Subwatershed 0303 Total			**3.288**	**679**	**0.48**	**597.6**	**0.55**
0701	71f	TNG110205	RMCF	0.109				
		TNG110235	RMCF	0.310				
	Subwatershed 0701 Total			**0.419**	**1165**	**0.04**	**525.8**	**0.08**

[a] Ref: Table 5 [b] Ref: Table 4

APPENDIX E

NPDES Permit No. TNR10-0000

General NPDES Permit for Storm Water Discharges Associated With Construction Activity

NPDES Permit No. TNR10-0000
General NPDES Permit for Storm Water Discharges Associated With Construction Activity

Information regarding permitting requirements for construction storm water may be downloaded from the TDEC website at:

http://www.state.tn.us/environment/permits/conststrm.php

NPDES Permit No. TNR10-0000, *General NPDES Permit for Storm Water Discharges Associated With Construction Activity* may also be downloaded from the TDEC website at:

http://www.state.tn.us/environment/permits/conststrmrul.pdf

The following is a summary of key provisions of NPDES Permit No. TNR10-0000, *General NPDES Permit for Storm Water Discharges Associated With Construction Activity*, that relate directly to implementation of Waste Load Allocations (WLAs) for sediment in impaired waterbodies in the Lower Duck River watershed.

Tennessee General Permit No. TNR10-0000, *General NPDES Permit for Storm Water Discharges Associated With Construction Activity* became effective on July 1, 2000 and is required for construction sites that disturb five acres or more. The permit authorizes storm water discharges from construction activities, storm water discharges from construction support activities, and certain non-storm water discharges associated with construction activities. The permit also covers discharges from construction sites that disturb less than five acres if the Director of the Division of Water Pollution Control has determined that the discharge from the site contributes to, or is likely to contribute to, a violation of a State water quality standard, or is likely to be a significant contributor of pollutants to the waters of the State. Discharges that result in violations of State water quality standards are prohibited. Construction activities are required to be carried out in such a manner to prevent violations of State water quality standards.

The permitted construction activity is required to develop, maintain, and implement a site-specific Storm Water Pollution Prevention Plan (SWPPP) to minimize erosion of soil and the discharge of pollutants to waters of the State. At a minimum, the SWPPP must include:

- Description of the site, description of the intended sequence of major activities which disturb soil, estimates of total area of the site and area disturbed, any data describing the soil or the quality of any site discharge, site location, identification of storm water outfalls, identification of receiving waters.

- Description of appropriate control measures and the general timing during the construction process that measures will be implemented. (The permit describes in some detail minimum requirements for: 1) erosion and sediment controls designed to retain sediment on site; 2) stabilization practices for disturbed portions of the site; 3) structural practices to divert flows from exposed soils, store flows, or otherwise limit runoff and pollutant discharge resulting from a 2 year, 24 storm (approximately 3.5 inches/24 hours for the Lower Duck River watershed); and 4) storm water management measures that will be installed after construction operations have been completed).

- Maintenance procedures to ensure that vegetation, erosion, and sediment control measures are kept in good and effective operating condition.

- A schedule of inspections by qualified personnel of disturbed areas of the construction site that are not fully stabilized, storage areas exposed to precipitation, structural control measures, outfall points, and locations where vehicles enter and exit the site. These inspections must be performed before certain anticipated storm events, within 24 hours after storm events of 0.5 inches , or greater, and at least once every two weeks (once per week for receiving streams listed on the 303(d) list for siltation). Based on the results of inspections, inadequate or damaged control measures must be modified or repaired as necessary before the next anticipated storm event (within seven days maximum). Also based on the results of inspections, pollution prevention measures must be revised as necessary within a specified time frame. Inspections must be documented.

- Sources of authorized non-storm water that are combined with storm water discharges associated with construction activity must be identified in the plan and appropriate pollution prevention measures for the non-storm water component of the discharge identified and implemented.

<u>Additional requirements are specified for discharges into waters listed on the Tennessee 303(d) list for siltation</u>. These additional requirements include:

- The SWPPP must be submitted to the local Environmental Assistance Center (EAC) prior to the start of construction.

- More frequent (weekly) inspections of erosion and sediment controls. Inspections and the condition of erosion and sediment controls must be certified to TDEC on a weekly basis.

- If TDEC learns that a discharge is causing a violation of water quality standards or contributing to the impairment of a 303(d) listed water, the discharger will be notified that the discharge is no longer eligible for coverage under the general permit and that additional discharges must be covered under an individual permit.